1929
AMERICAN GAS CATALOG *and* HANDBOOK

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1929

American Gas Catalog and Handbook

EIGHTH EDITION

Engineering data contained herein cover the various operations in every department of the gas plant.

Gas merchandising, industrial and domestic installations, house heating, refrigeration and incineration are treated in a practical manner

Compiled, edited and published by

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PREFACE

THE AMERICAN GAS CATALOG AND HANDBOOK, published for seven years as The American Gas Catalog, was always a combination of valuable announcements of advertisers and of data material on the manufacture, distribution and use of gaseous fuel. This, the eighth consecutive publication of this book, which has come to be considered as a standard of its kind in the gas industry, is termed THE AMERICAN GAS CATALOG AND HANDBOOK, to call the attention of its users to the fact that it is a combination book, which contains important information not only in its data pages but in its advertising pages as well. The user of this book will make best use of it by consulting all its pages and parts.

The handbook portion, which contains tables, charts and other information on the manufacture, distribution and sale of gas, has been compiled on the principle that tabulated and graphical information is best suited for this particular purpose. A handbook is essentially and should be a reference book, one that is consulted many times daily in the course of the user's work. Such a book must contain its information in such form as to be easily understood and applied. The data contained in it must be accurate and reliable, and the tables and charts must be in proper condition to be readily used.

THE AMERICAN GAS CATALOG AND HANDBOOK is a book of such character, and every effort has been made to make it authoritative and accurate, useful and usable. The material contained in it has been collected, as has been our practice for the past seven years, from many different sources, some of which have been supplied to us with the express request that we take from them whatever we need for our purpose. We refer primarily here to the manufacturers' catalogs and trade literature. We have also made use of textbooks, handbooks, reports of various gas associations and other trade associations in our quest for tabular and graphical data of interest and value to the gas man. Various changes, too numerous to mention, have been made better to adapt this information to the purpose of the gas man.

THE AMERICAN GAS CATALOG AND HANDBOOK must always constitute a collection of information gathered from numerous sources and the value of the book depends on the co-operation that its editor receives from the gas industry as a whole. Our thanks are due to all who have co-operated with us in the compilation of this edition and we take this opportunity of acknowledging our indebtedness to them.

Index to Handbook

Index to Tables and Illustrations

Index to Advertisers American Gas Catalog and Handbook

1929

Classified Index to Advertised Products

American Gas Catalog and Handbook

This section of the American Gas Catalog and Handbook has been compiled to make it of greatest service to you.

A questionnaire was sent to everyone making anything that is used in any department of the gas plant. Those that replied are listed under the proper headings, whether their announcement appears in this Catalog or not. We believe this to be the most complete list of products ever issued to the gas industry.

We will welcome suggestions as to how we can make this section more valuable to you in future issues.

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Mulcare Engineering Co., New York, N. Y.

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Gas Manufacturing Section

American Gas Catalog and Handbook

The Gas Manufacturing Section contains a number of divisions, corresponding to the nature of the gas manufactured and also the operations carried out in the gas works. Thus, there is a Water Gas Division, a Coal Gas Division, a Coke Oven Gas Division, a portion devoted to Purification of Gas, to the operation of the Boiler Plant, etc., etc.

This year an additional division has been added, that on Natural Gas. It should, however, be remembered that many of the general tabulations and charts which are included in the other divisions in this Section also apply to natural gas. Furthermore, additional material on Natural Gas is given in the Distribution Section.

Each division contains information which is specially adapted to it and also numerous tables, charts and general reading matter which may find use by those interested mainly in other divisions. The reader is therefore urged to consult the entire Section rather than stopping at any individual division of it.

Considerable valuable matter that has not yet been published in any Manufacturing Section of the American Gas Catalog has been added this year, and the most valuable of the data published last year has been retained.

Particular attention is called to the data on flow of gas wells, on casing specifications, capacities of choke nipples and orifices contained in the natural gas division.

Some very useful new conversion tables have been added as well as tables giving detailed information on the calorific value of gases in different units, on various chemical compounds with which the gas man has to deal and their formulae, molecular weights, solubilities, etc.

A very valuable chart is one which shows the volume of a cone, very useful in the calculation of the amount of coal in a pile. Interesting material on conveyors, the cost of oxide purification, capacities of pumps, correction of B.T.U. value of gas determined under different conditions of room temperature and air humidity, etc., are included.

COAL GAS

In accordance with the precedent set in the 1927 edition of the American Gas Catalog, the 1929 edition contains predominantly tabular matter and charts and curves, reading matter of a descriptive nature being kept down to a minimum. It has thus been possible to gixe a maximum of valuable information in a minimum of space.

B.T.U. CORRECTION FOR COAL GAS

The accompanying table gives the corrections that are necessary when determining the calorific value of illuminating gas of about 600 B.T.U. heat content per cubic foot. These corrections are applicable in calculating total heating values, when inlet water, air, gas and products are all approximately at the same temperature and when the calorimeter is operated at normal rate of gas consumption.

Thus, if the B.T.U. found is 595 B.T.U. at a room temperature of 60 degrees F., and with a relative humidity in the air of 60 per cent, a correction must be applied. This correction is found in the table as plus one B.T.U. by running down column marked 60 per cent and running across row marked 60 degrees F.

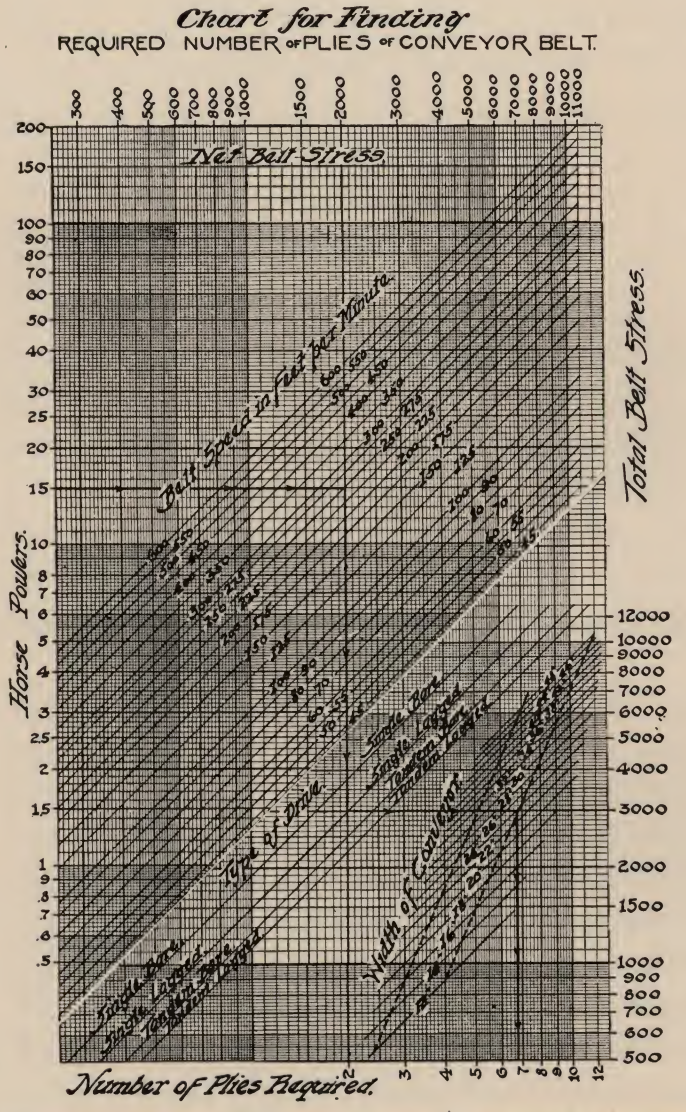
Temperature of room, etc.	Relative humidity of air									
	10 per cent	20 per cent	30 per cent	40 per cent	50 per cent	60 per cent	70 per cent	80 per cent	90 per cent	100 per cent
F										
40	+ 2	+ 2	+ 1	+ 1	+ 1	+ 1	0	0	0	— 1
45	+ 2	+ 2	+ 2	+ 1	+ 1	+ 1	0	0	0	— 1
50	+ 3	+ 3	+ 2	+ 2	+ 1	+ 1	0	0	0	— 1
55	+ 3	+ 3	+ 3	+ 2	— 1	+ 1	+ 1	0	0	— 1
60	+ 4	+ 4	+ 3	+ 2	+ 2	+ 1	+ 1	0	0	— 1
65	+ 5	+ 4	+ 4	+ 3	+ 2	+ 2	+ 1	0	— 1	— 1
70	+ 6	+ 5	+ 4	+ 3	+ 3	+ 2	+ 1	0	— 1	— 2
75	+ 7	+ 6	+ 5	+ 4	+ 3	+ 2	+ 1	+ 0	— 1	— 2
80	+ 8	+ 7	+ 6	+ 5	+ 4	+ 3	+ 1	0	— 1	— 2
85	+10	+ 9	+ 7	+ 6	+ 4	+ 3	+ 2	0	— 1	— 3
90	+12	+10	+ 9	+ 7	+ 5	+ 4	+ 2	0	— 2	— 3
95	+14	+12	+10	+ 8	+ 6	+ 4	+ 2	0	— 2	— 4

TEMPERATURE AND IMPURITIES IN RAW GASES AT OUTLET OF HYDRAULIC MAIN OR WASH BOX

	Coal Gas	Blue Gas	Carburetted Blue Gas	Pac. Coast Oil Gas
Temperature (degrees Fahrenheit)	140-190	160-200	160-200	150-200
Impurities				
Per cent by volume				
Water vapor	19-30	32-78	32-78	25-78
Ammonia	1-2	....	....	....
Tar and oil vapors	2-3.5	xx	1-2	1-1.5
Grains per 100 cubic feet				
Cyanogen	50-70	x	x	....
Naphthalene	200-500	....	80-250	150-600
Hydrogen sulfide	500-800	100-200	120-300	200-300
Organic sulfur	35-50	x	10-30	20-30

x No figures available. xx Small amounts with bitumin ous coal.

PLIES OF CONVEYOR BELT



To find the required number of plies for a conveyor belt with a given horsepower, speed, type of drive, and width of conveyor: Enter the chart at the left margin, with the horsepower required to drive the conveyor, follow this horsepower line to its intersection with the diagonal representing the speed of the conveyor in feet per minute, then down vertically to the line representing the type of drive, thence to the right to the conveyor width line, and then down to the bottom margin where the required number of plies is read.

This chart assumes 28 oz. duck for belt ply. If 32 oz. duck is used, divide result by 1.23. If 36 oz. duck is used, divide result by 1.35.

The heavy line shows the solution for a 24″ conveyor with a single-lagged drive, running 250 feet a minute, and requiring 15 h.p. A belt having 6.8 plies is called for, and from the table of equivalents, either a 7 x 6 x ⅛″ belt or an 8 x 6 x 3/16″ belt would be selected, depending on the abrasive tendencies of the material carried.

NOTE: For tail-driven or center-driven conveyors, thicker belts will be needed if the inclination of the conveyor exceeds 6°. Values found outside of the heavy dotted lines crossing the set of width lines will call for belts either too thick to trough well or too thin to sustain the load properly between idlers.

TEMPERATURE	BAROMETER																			
	28.6	28.7	28.8	28.9	29.0	29.1	29.2	29.3	29.4	29.5	29.6	29.7	29.8	29.9	30.0	30.1	30.2	30.3	30.4	30.5
107	.816	.820	.823	.826	.829	.832	.835	.838	.841	.844	.847	.851	.854	.857	.860	.864	.867	.870	.874	.877
106	.820	.823	.826	.829	.832	.835	.838	.841	.844	.847	.851	.854	.857	.860	.863	.867	.870	.874	.878	.881
105	.823	.827	.830	.833	.836	.839	.842	.845	.848	.851	.855	.858	.861	.864	.867	.871	.874	.878	.881	.884
104	.827	.830	.833	.836	.839	.842	.845	.848	.851	.854	.858	.861	.864	.867	.871	.874	.878	.881	.884	.887
103	.830	.834	.837	.840	.843	.847	.849	.852	.855	.858	.862	.865	.868	.871	.874	.878	.881	.885	.888	.891
102	.834	.837	.840	.843	.847	.850	.853	.856	.859	.862	.865	.868	.871	.874	.878	.881	.885	.888	.891	.894
101	.837	.840	.843	.846	.850	.853	.856	.859	.862	.865	.868	.872	.875	.878	.882	.885	.888	.891	.895	.898
100	.840	.843	.846	.849	.853	.856	.859	.862	.865	.868	.872	.875	.878	.881	.885	.888	.891	.895	.898	.901
99	.844	.847	.850	.853	.857	.860	.863	.866	.869	.872	.875	.879	.882	.885	.889	.892	.895	.898	.902	.905
98	.847	.850	.853	.856	.860	.863	.866	.869	.872	.875	.879	.882	.885	.888	.892	.895	.898	.902	.905	.908
97	.850	.853	.856	.859	.863	.866	.870	.873	.876	.879	.882	.885	.888	.891	.894	.898	.901	.905	.908	.911
96	.854	.857	.860	.863	.867	.870	.873	.876	.879	.882	.886	.889	.892	.895	.898	.901	.904	.908	.911	.914
95	.857	.860	.863	.866	.870	.873	.876	.879	.882	.885	.889	.892	.895	.898	.901	.904	.908	.911	.914	.918
94	.860	.863	.866	.869	.873	.876	.879	.882	.885	.888	.892	.895	.898	.901	.904	.907	.911	.914	.918	.921
93	.863	.866	.869	.872	.876	.879	.883	.886	.889	.891	.895	.898	.901	.904	.907	.910	.914	.918	.921	.924
92	.866	.869	.872	.875	.879	.882	.885	.889	.892	.894	.898	.902	.904	.907	.910	.914	.917	.921	.924	.928
91	.869	.872	.875	.879	.882	.885	.889	.892	.895	.898	.902	.905	.908	.911	.914	.917	.921	.924	.928	.931
90	.872	.875	.878	.881	.885	.888	.892	.895	.898	.901	.905	.908	.911	.914	.917	.920	.924	.927	.931	.934
89	.875	.878	.882	.885	.889	.892	.895	.898	.901	.904	.907	.910	.914	.917	.920	.923	.927	.931	.934	.937
88	.878	.881	.885	.888	.892	.895	.898	.901	.904	.907	.910	.913	.917	.920	.923	.926	.930	.934	.937	.940
87	.881	.884	.888	.891	.895	.898	.901	.904	.907	.910	.913	.916	.920	.923	.926	.929	.933	.937	.940	.943
86	.884	.887	.890	.894	.898	.901	.904	.907	.910	.913	.916	.919	.923	.926	.929	.932	.936	.940	.943	.946
85	.887	.890	.893	.896	.900	.903	.906	.909	.913	.916	.919	.922	.926	.929	.932	.936	.939	.943	.946	.949
84	.889	.893	.896	.899	.903	.906	.909	.912	.915	.919	.922	.925	.928	.932	.935	.939	.942	.946	.949	.952
83	.892	.895	.899	.902	.906	.909	.912	.915	.918	.921	.924	.928	.931	.935	.938	.942	.945	.949	.952	.955
82	.895	.898	.901	.905	.908	.911	.914	.918	.921	.924	.927	.931	.934	.937	.941	.945	.948	.951	.954	.958
81	.898	.901	.905	.908	.911	.914	.917	.921	.924	.927	.930	.934	.937	.940	.944	.948	.951	.954	.957	.960
80	.901	.904	.907	.910	.914	.917	.920	.923	.927	.930	.933	.937	.940	.943	.946	.950	.954	.957	.960	.963
79	.904	.907	.910	.914	.917	.920	.923	.926	.930	.933	.936	.939	.943	.946	.949	.953	.956	.960	.963	.967
78	.906	.909	.913	.916	.919	.923	.926	.929	.932	.936	.939	.942	.946	.949	.952	.956	.959	.962	.966	.969
77	.909	.912	.915	.919	.922	.925	.928	.931	.935	.938	.942	.945	.948	.951	.955	.958	.962	.965	.968	.972
76	.911	.915	.918	.921	.925	.928	.931	.935	.938	.941	.944	.948	.951	.954	.958	.961	.964	.968	.971	.975
75	.914	.917	.921	.924	.928	.931	.934	.937	.940	.943	.947	.950	.954	.957	.960	.963	.967	.971	.974	.978
74	.917	.920	.924	.927	.930	.933	.937	.940	.943	.947	.950	.953	.957	.960	.963	.966	.970	.973	.977	.980
73	.920	.923	.926	.930	.933	.936	.940	.943	.946	.949	.953	.956	.960	.963	.966	.969	.972	.976	.980	.983
72	.922	.925	.929	.932	.935	.939	.942	.945	.949	.952	.955	.959	.962	.965	.968	.972	.975	.979	.982	.986
71	.925	.928	.931	.935	.938	.941	.945	.948	.951	.954	.958	.961	.965	.968	.971	.975	.978	.981	.985	.989
70	.927	.931	.934	.937	.941	.944	.947	.950	.954	.957	.960	.964	.967	.970	.974	.977	.980	.984	.988	.991
69	.930	.933	.937	.940	.944	.947	.950	.953	.957	.960	.963	.967	.970	.973	.977	.980	.983	.987	.990	.994
68	.932	.936	.939	.942	.946	.949	.952	.956	.959	.962	.966	.969	.972	.976	.979	.983	.986	.989	.993	.997
67	.935	.938	.942	.945	.949	.952	.955	.959	.962	.965	.968	.972	.975	.979	.982	.985	.989	.992	.996	1.000
66	.938	.941	.944	.948	.951	.954	.958	.961	.964	.968	.971	.974	.978	.981	.985	.988	.992	.995	.998	1.002
65	.941	.944	.947	.950	.954	.957	.960	.963	.967	.970	.973	.977	.980	.984	.987	.991	.994	.997	1.001	1.005
64	.943	.946	.949	.953	.956	.959	.963	.966	.969	.973	.976	.980	.983	.986	.990	.994	.997	1.000	1.004	1.008
63	.945	.949	.952	.955	.959	.962	.965	.969	.972	.975	.979	.982	.985	.989	.993	.996	1.000	1.003	1.006	1.010
62	.947	.951	.954	.958	.961	.964	.968	.971	.975	.978	.981	.985	.988	.991	.995	.999	1.002	1.005	1.009	1.013
61	.950	.954	.957	.961	.964	.967	.971	.974	.977	.981	.984	.987	.991	.994	.998	1.001	1.005	1.008	1.011	1.015
60	.952	.956	.959	.963	.966	.969	.973	.976	.980	.983	.986	.990	.993	.997	1.000	1.004	1.007	1.010	1.014	1.017
59	.955	.959	.962	.966	.969	.972	.976	.979	.983	.986	.989	.992	.995	.999	1.003	1.006	1.010	1.013	1.016	1.020
58	.957	.961	.964	.968	.971	.975	.978	.981	.985	.988	.992	.995	.998	1.002	1.005	1.009	1.012	1.016	1.019	1.023
57	.960	.963	.967	.970	.974	.977	.980	.984	.988	.991	.994	.997	1.000	1.004	1.007	1.011	1.014	1.018	1.021	1.025
56	.962	.966	.969	.973	.976	.979	.982	.986	.990	.993	.996	1.000	1.003	1.007	1.010	1.014	1.017	1.021	1.024	1.028
55	.965	.968	.972	.975	.979	.982	.985	.989	.993	.996	.999	1.002	1.006	1.009	1.013	1.016	1.020	1.023	1.027	1.030
54	.967	.970	.974	.977	.981	.984	.988	.991	.995	.998	1.001	1.005	1.008	1.012	1.015	1.019	1.022	1.026	1.029	1.033
53	.969	.973	.976	.980	.983	.986	.990	.993	.997	1.000	1.004	1.007	1.011	1.014	1.018	1.021	1.025	1.028	1.031	1.035
52	.971	.975	.978	.982	.985	.989	.992	.996	.999	1.003	1.006	1.010	1.013	1.017	1.020	1.024	1.027	1.031	1.034	1.038
51	.974	.977	.981	.984	.988	.991	.995	.998	1.002	1.005	1.009	1.012	1.016	1.019	1.023	1.026	1.030	1.033	1.037	1.040
50	.976	.980	.983	.987	.990	.994	.997	1.001	1.004	1.008	1.011	1.015	1.018	1.022	1.025	1.029	1.032	1.036	1.039	1.043
49	.979	.982	.986	.989	.993	.996	1.000	1.003	1.007	1.010	1.014	1.017	1.021	1.024	1.028	1.031	1.035	1.038	1.042	1.045
48	.981	.985	.988	.992	.995	.999	1.002	1.006	1.009	1.013	1.016	1.020	1.023	1.027	1.030	1.034	1.037	1.041	1.044	1.048
47	.984	.987	.991	.994	.998	1.001	1.005	1.008	1.012	1.015	1.019	1.022	1.026	1.029	1.033	1.036	1.040	1.043	1.047	1.050
46	.986	.990	.993	.997	1.000	1.004	1.007	1.011	1.014	1.018	1.021	1.025	1.028	1.032	1.035	1.039	1.042	1.046	1.049	1.053
45	.989	.992	.996	.999	1.003	1.006	1.010	1.013	1.017	1.020	1.024	1.027	1.031	1.034	1.038	1.041	1.045	1.048	1.052	1.056
44	.991	.994	.998	1.001	1.005	1.008	1.012	1.015	1.019	1.022	1.026	1.029	1.033	1.036	1.040	1.043	1.047	1.050	1.054	1.058
43	.993	.997	1.001	1.004	1.008	1.011	1.015	1.018	1.022	1.025	1.029	1.032	1.036	1.039	1.043	1.046	1.050	1.053	1.057	1.060
42	.995	.999	1.003	1.006	1.010	1.013	1.017	1.020	1.024	1.027	1.031	1.034	1.038	1.041	1.045	1.048	1.052	1.055	1.059	1.063
41	.998	1.001	1.005	1.009	1.012	1.016	1.019	1.023	1.026	1.030	1.034	1.037	1.041	1.044	1.048	1.051	1.055	1.058	1.062	1.065
40	1.000	1.004	1.007	1.011	1.014	1.018	1.021	1.025	1.028	1.032	1.036	1.039	1.043	1.046	1.050	1.053	1.057	1.060	1.063	1.068
39	1.002	1.006	1.010	1.013	1.017	1.020	1.024	1.028	1.031	1.035	1.038	1.042	1.045	1.049	1.052	1.056	1.059	1.063	1.066	1.070

TEMPERATURE	BAROMETER																			
	28.6	28.7	28.8	28.9	29.0	29.1	29.2	29.3	29.4	29.5	29.6	29.7	29.8	29.9	30.0	30.1	30.2	30.3	30.4	30.5
38	1.005	1.009	1.012	1.016	1.020	1.023	1.027	1.030	1.034	1.037	1.041	1.044	1.048	1.051	1.055	1.058	1.062	1.065	1.069	1.073
37	1.007	1.011	1.015	1.018	1.022	1.025	1.029	1.032	1.036	1.039	1.043	1.046	1.050	1.053	1.057	1.060	1.064	1.068	1.072	1.076
36	1.009	1.013	1.017	1.020	1.024	1.027	1.031	1.035	1.038	1.042	1.045	1.049	1.052	1.056	1.060	1.063	1.067	1.071	1.074	1.078
35	1.012	1.015	1.019	1.022	1.026	1.030	1.033	1.037	1.041	1.044	1.048	1.051	1.055	1.058	1.062	1.065	1.069	1.073	1.077	1.081
34	1.014	1.018	1.022	1.025	1.029	1.032	1.036	1.040	1.043	1.047	1.050	1.054	1.057	1.061	1.064	1.068	1.072	1.075	1.079	1.083
33	1.016	1.020	1.024	1.027	1.031	1.034	1.038	1.042	1.046	1.049	1.053	1.056	1.060	1.063	1.067	1.070	1.074	1.078	1.082	1.086
32	1.019	1.023	1.027	1.030	1.034	1.037	1.041	1.044	1.048	1.051	1.055	1.058	1.062	1.066	1.069	1.073	1.077	1.081	1.085	1.089
31	1.021	1.025	1.029	1.032	1.036	1.039	1.043	1.047	1.050	1.054	1.057	1.061	1.064	1.068	1.072	1.075	1.079	1.083	1.087	1.091
30	1.023	1.027	1.031	1.034	1.038	1.042	1.045	1.049	1.053	1.056	1.060	1.063	1.067	1.071	1.074	1.078	1.082	1.086	1.090	1.094
29	1.026	1.030	1.033	1.037	1.040	1.044	1.048	1.051	1.055	1.058	1.062	1.065	1.069	1.073	1.076	1.080	1.084	1.088	1.092	1.096
28	1.028	1.032	1.036	1.039	1.043	1.047	1.050	1.054	1.058	1.061	1.065	1.068	1.072	1.075	1.079	1.083	1.087	1.091	1.095	1.099
27	1.030	1.034	1.038	1.041	1.045	1.049	1.053	1.056	1.060	1.063	1.067	1.070	1.074	1.078	1.082	1.086	1.090	1.094	1.098	1.102
26	1.033	1.037	1.041	1.044	1.048	1.051	1.055	1.059	1.062	1.066	1.069	1.073	1.077	1.080	1.084	1.088	1.092	1.096	1.100	1.104
25	1.035	1.039	1.043	1.046	1.050	1.054	1.057	1.061	1.065	1.068	1.072	1.075	1.079	1.083	1.086	1.090	1.094	1.098	1.102	1.106
24	1.037	1.041	1.045	1.048	1.052	1.056	1.060	1.064	1.067	1.071	1.074	1.078	1.081	1.085	1.089	1.093	1.097	1.101	1.105	1.109
23	1.040	1.044	1.048	1.051	1.055	1.058	1.062	1.066	1.069	1.073	1.076	1.080	1.084	1.088	1.092	1.095	1.099	1.103	1.107	1.111
22	1.042	1.046	1.050	1.053	1.057	1.061	1.065	1.068	1.072	1.075	1.079	1.083	1.086	1.090	1.094	1.098	1.102	1.106	1.110	1.114
21	1.044	1.048	1.052	1.055	1.059	1.063	1.067	1.071	1.074	1.078	1.081	1.085	1.089	1.093	1.096	1.100	1.104	1.108	1.112	1.116
20	1.047	1.051	1.055	1.058	1.062	1.065	1.069	1.073	1.076	1.080	1.084	1.087	1.091	10.95	1.099	1.103	1.107	1.111	1.115	1.119
19	1.050	1.054	1.058	1.061	1.065	1.068	1.072	1.076	1.079	1.083	1.087	1.090	1.094	1.098	1.102	1.106	1.110	1.114	1.118	1.122
18	1.052	1.056	1.060	1.063	1.067	1.070	1.074	1.078	1.082	1.085	4.089	1.093	1.096	1 100	1.104	1.108	1.112	1.116	1.120	1.124
17	1.055	1.059	1.062	1.066	1.069	1.073	1.076	1.080	1 084	1.088	1.091	1.095	1 098	1.102	1.106	1.110	1.114	1.118	1 122	1 126
16	1.057	1.061	1.064	1.068	1 071	1.075	1.079	1.083	1.086	1.090	1.094	1.098	1.101	1.105	1.109	1.113	1.117	1.121	1.125	1.129
15	1.059	1.063	1.066	1.070	1 074	1.077	1.081	1.085	1.088	1.092	1.096	1.100	1.103	1.107	1.111	1.115	1.119	1 123	1 127	1 131
14	1.062	1.066	1.069	1.073	1.076	1.080	1.084	1.087	1.091	1.095	1.099	1.102	1.106	1.110	1.114	1.117	1 121	1 125	1.129	1 133
13	1.064	1 068	1.071	1.075	1.078	1.082	1.086	1.090	1.094	1.097	1.101	1.105	1.109	1.112	1.116	1.120	1.124	1.128	1.132	1 136
12	1.066	1.070	1.073	1.077	1.080	1.084	1.088	1.092	1.096	1.100	1.103	1.107	1.111	1.115	1.119	1.122	1 126	1.130	1 134	1 138
11	1.069	1 073	1.076	1.080	1.083	1.087	1.091	1.095	1.098	1.102	1.106	1.110	1.114	1.117	1.121	1.125	1.129	1.133	1.137	1.141
10	1 071	1.075	1.078	1.082	1.086	1.090	1.093	1.097	1.101	1.105	1 108	1.112	1.116	1.120	1.123	1.127	1.131	1.135	1 139	1.143
9	1 073	1.077	1.081	1.084	1.088	1.092	1.095	1.099	1.103	1.107	1.111	1.114	1.118	1 122	1.126	1.130	1.133	1.137	1.141	1 145
8	1.076	1.079	1.083	1 086	1.090	1.094	1.098	1.102	1.105	1.109	1.113	1.117	1.121	1.125	1.128	1.132	1 136	1.140	1.144	1 148
7	1 078	1.082	1.085	1 089	1 093	1 096	1 100	1.104	1 108	1.112	1.115	1 119	1.123	1.127	1.131	1.135	1 139	1 143	1.146	1 151
6	1.080	1.084	1.088	1.091	1.095	1.099	1.103	1.107	1.111	1.114	1.118	1 122	1.126	1.130	1.133	1.137	1.141	1 145	1.149	1.153
5	1.083	1.087	1.090	1.094	1 098	1.102	1.105	1.109	1.113	1.117	1 120	1.124	1.128	1.132	1.136	1.140	1.144	1.148	1.152	1.156
4	1.085	1.089	1.092	1.096	1.100	1.104	1 108	1.111	1.115	1.119	1 123	1.126	1.130	1.134	1.138	1.142	1.146	1.150	1.154	1.158
3	1.088	1.092	1.095	1 099	1.103	1.107	1.111	1.114	1.118	1.122	1 126	1.129	1.133	1.137	1.141	1.145	1 149	1 153	1.157	1.161
2	1 090	1 094	1.098	1.101	1.105	1.109	1.113	1.117	1.121	1.125	1.128	1.132	1 136	1.140	1.144	1.148	1.152	1.156	1.160	1.164
1	1.093	1.097	1.100	1.104	1.108	1.111	1.115	1.119	1 123	1.127	1.131	1.135	1 139	1.143	1.146	1.150	1.154	1.158	1.162	1 166
0	1.095	1 099	1.103	1.107	1.111	1.114	1.118	1 122	1.126	1 130	1.133	1.137	1 141	1 145	1 149	1.153	1.157	1 161	1 165	1.169
−1	1.098	1.102	1.106	1 109	1.113	1 117	1.121	1.124	1.128	1.132	1.136	1.140	1.144	1.148	1 152	1.156	1.160	1.164	1.168	1.172
−2	1.101	1.105	1.108	1.112	1 116	1.120	1 123	1 127	1.131	1.135	1.138	1.142	1.146	1.150	1.154	1.158	1.162	1.166	1.170	1.174
−3	1.103	1.107	1.111	1.115	1.119	1 122	1.126	1.130	1.134	1.137	1.141	1.145	1 149	1 153	1.157	1.161	1.165	1.169	1.173	1.177
−4	1.106	1.110	1.113	1 117	1.121	1.125	1.129	1.133	1.136	1.140	1.144	1.148	1.152	1 156	1 160	1.164	1.168	1.172	1.176	1.180
−5	1.109	1.113	1.116	1.120	1.124	1.128	1.132	1.136	1.140	1 144	1.147	1.151	1 155	1 159	1.163	1 167	1.171	1.175	1.179	1.183
−6	1.111	1.115	1.119	1.123	1.126	1.130	1.134	1 138	1.142	1.146	1.149	1.153	1.157	1 161	1.165	1.169	1.173	1.177	1 181	1.185
−7	1.114	1.117	1.121	1.125	1.129	1.133	1.137	1.141	1.144	1.149	1.153	1.156	1.160	1.164	1.168	1.172	1.176	1.180	1.184	1 188
−8	1.116	1.120	1.124	1.128	1.133	1 136	1.140	1.144	1.147	1.151	1.154	1 158	1 162	1.166	1.170	1.174	1.178	1.182	1 186	1.190
−9	1.119	1 122	1.126	1.130	1 134	1.138	1.142	1.146	1 150	1.153	1.157	1.161	1.165	1.169	1.173	1.177	1 181	1.185	1.189	1.193
−10	1 121	1.125	1 129	1.133	1.137	1.141	1 145	1.149	1.152	1.156	1.160	1.164	1.168	1 172	1.176	1.180	1.184	1.188	1.192	1 196
−11	1.124	1.128	1.132	1.136	1.140	1.144	1.147	1.151	1.155	1 159	1.163	1 167	1.171	1.175	1.179	1.183	1.187	1.191	1 195	1 199
−12	1.126	1.130	1.134	1 138	1.142	1.146	1.150	1 154	1 158	1.161	1 165	1 169	1.173	1.177	1 181	1 185	1.189	1 193	1.197	1 201
−13	1 129	1.133	1.137	1.141	1.145	1 149	1.153	1.157	1.160	1 164	1.168	1.172	1.176	1.180	1 184	1.188	1 192	1 196	1.200	1.204
−14	1.131	1 135	1.139	1.143	1.147	1 151	1.155	1 159	1 163	1.167	1.171	1.175	1.179	1.183	1.187	1.191	1.195	1.199	1.203	1.207
−15	1 134	1.138	1 142	1 146	1.150	1 154	1.158	1.162	1 165	1.169	1.173	1.177	1 181	1.185	1.189	1.193	1.197	1.201	1.205	1.209
−16	1.136	1.140	1.144	1.148	1.152	1.156	1.160	1.164	1.168	1.172	1.176	1.180	1.184	1.188	1.192	1.196	1.200	1.204	1.208	1.212
−17	1.139	1.143	1.147	1.151	1.155	1.159	1.163	1.167	1.171	1.175	1.179	1.183	1.187	1.191	1.195	1.199	1.203	1.207	1.211	1.215
−18	1.142	1.146	1.150	1.154	1.158	1.162	1.166	1.170	1.174	1.178	1.182	1.186	1.190	1.194	1.198	1.202	1.206	1.210	1.214	1.218
−19	1.144	1.148	1.152	1.156	1.160	1.164	1.168	1.172	1.176	1.180	1.184	1.188	1.192	1.196	1.200	1.204	1.208	1.212	1.216	1.220
−20	1.147	1.151	1.155	1.159	1.163	1.167	1.171	1.175	1.179	1.183	1.187	1.191	1.195	1.199	1.203	1.207	1.211	1.215	1.219	1.223
−21	1.150	1.154	1.158	1.162	1.166	1.170	1.174	1.178	1.182	1.186	1.190	1.194	1.198	1.202	1.206	1.210	1.214	1.218	1.222	1.226
−22	1.152	1.156	1.160	1.164	1.168	1.172	1.176	1.180	1.184	1.188	1.192	1.197	1.201	1.205	1.209	1.213	1.217	1.221	1.225	1.229
−23	1.155	1.159	1.163	1.167	1.171	1.175	1.179	1.183	1.187	1.191	1.195	1.199	1.203	1.207	1.211	1.215	1.219	1.224	1.228	1.232
−24	1.157	1.161	1.165	1.169	1.173	1.177	1.181	1.186	1.190	1.194	1.198	1.202	1.206	1.210	1.214	1.218	1.222	1.226	1.230	1.234
−25	1.160	1.164	1.168	1.172	1.176	1.180	1.184	1.188	1.192	1.196	1.200	1.204	1.208	1.212	1.217	1.221	1.225	1.229	1.233	1.237
−26	1.163	1.167	1.171	1.175	1.179	1.183	1.187	1.191	1.195	1.199	1.203	1.207	1.211	1.215	1.219	1.223	1.228	1.232	1.236	1.240
−27	1.165	1.169	1.173	1.177	1.181	1.185	1.190	1.194	1.198	1.202	1.206	1.210	1.214	1.218	1.222	1.226	1.230	1.235	1.239	1.243
−28	1.168	1.172	1.176	1.180	1.184	1.188	1.192	1.196	1.200	1.205	1.209	1.213	1.217	1.221	1.225	1.229	1.233	1.237	1.241	1.245
−29	1.170	1.175	1.179	1.183	1.187	1.191	1.195	1.199	1.203	1.207	1.212	1.216	1.220	1.224	1.228	1.232	1.236	1.240	1.244	1.248
−30	1.173	1.177	1.181	1.186	1.190	1.194	1.198	1.202	1.206	1.210	1.214	1.218	1.222	1.227	1.231	1.235	1.239	1.243	1.247	1.251

Observed volume multiplied by factor corresponding to observed temperature and barometric pressure equals corrected volume.

CORRECTING VOLUMES FOR PRESSURE AND TEMPERATURE

The table on the opposite page is used in the following manner. If the measured volume of gas is 150,000 cubic feet and if the temperature at which the gas was measured is 65 degrees F. and the corresponding barometic reading 29.9 inches of mercury, then the volume corrected to standard conditions of temperature and pressure will be obtained by multiplying the observed volume by the factor found from the table. This factor will be found in the column headed 29.9 inches and the row headed 75 degrees F., namely, 0.957.

$0.957 \times 150{,}000 = 143{,}550$ cubic feet.

HYDROCARBONS IN LOW TEMPERATURE GAS

(Average Composition of Gas)

	Per Cent
Carbon dioxide	11.0
Hydrogen sulfide	1.0
Nitrogen	1.1
Oxygen	0.0
Hydrogen	33.5
Carbon monoxide	11.7
Methane	32.4
Ethylene	0.92
Acetylene	0.00
Ethane	3.8
Propylene	0.87
Propadiene	Undetected
Methylacetylene	0.00
Propane	1.33
Cyclopropane	Undetected
Unsym-dimethylethylene	0.21
Sym-dimethylethylene	0.18
1,3-Butadiene	0.002+
n-Butane	0.28
Isobutane	0.09
Methylpropadiene	Undetected—less than 0.003
Ethylacetylene	0.00
Methylcyclopropane	0.00
Cyclobutane	Undetected—less than 0.05
Sym-dimethylacetylene	Undetected
Higher hydrocarbons	Not studied

COMPARATIVE TESTS SHOWING AVERAGE SIZE OF COKE COOLED BY WET AND DRY METHOD

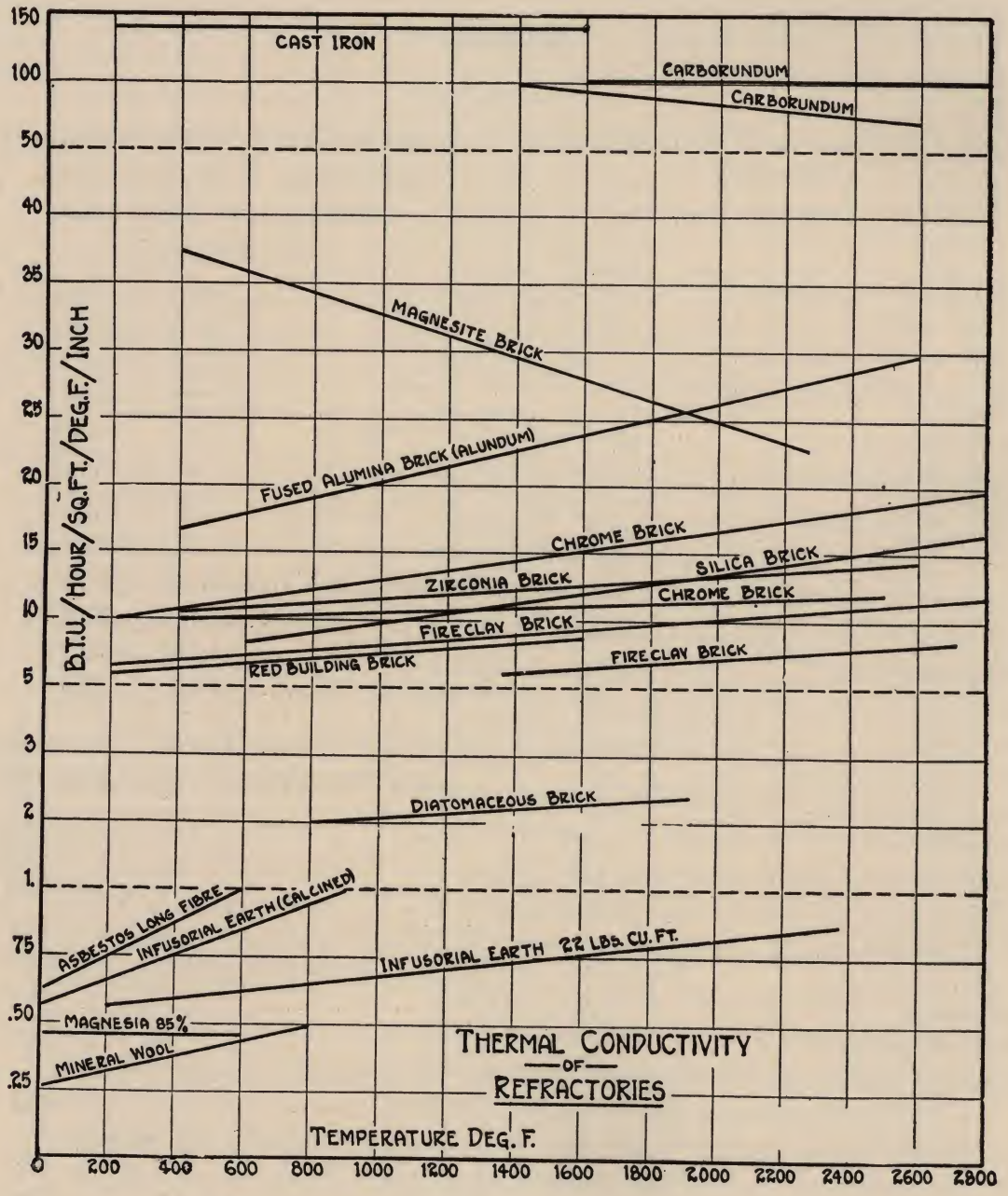
Screen	Dry Quenched Coke at Wharf After Passing Through Container	Wet Quenched Coke Run Through Dry Quencher Cold Container
% on 4 inch	.92	1.09
3 inch	7.27	7.26
2 inch	31.70	31.90
Total on 2 inch	39.89	40.25
1 inch	41.90	42.00
½ inch	9.70	8.72
Through ½ inch	8.48	8.79

AVERAGE COEFFICIENT OF EXPANSION OF REFRACTORY OXIDES

	Coefficient of Expansion x 10^{-6} (25° to 800° C.)
Alumina, refractory made of	7.9
Magnesia, refractory made of	13.4
Silica	0.5
Thoria	9.3
Zirconia, parallel to long axis of crystal	8.1
Zirconia, perpendicular to long axis of crystal	7.3
Zirconia, refractory made of	6.6

VARIATION IN THERMAL CONDUCTIVITY OF REFRACTORIES WITH TEMPERATURE

The thermal conductivity of refractories varies with the temperature. Thus, as a general rule, as the temperature rises, the number of British thermal units of heat conducted per hour per square foot per degree F. difference in temperature and per inch of thickness of the refractory material increases. This may be seen from the accompanying chart, and also that there are certain exceptions to the rule, namely, magnesia 85 per cent, cast iron and a certain type of carborundum which do not change in conductivity over a certain



range of temperature increase, while magnesite brick acts differently from all the others in decreasing in heat conductivity as the temperature increases.

The chart is useful in determining the changes in heat conductivity of various refractories over a certain temperature range. Thus, in the case of magnesite brick, the heat conductivity at 400 degrees F. is 30 B.t.u. per hour, per square foot, per degree F, per inch, while at 2,000 degrees F. it is only 25 B.t.u. per hour, per square foot, per degree F., per inch. On the other hand, magnesia 85 per cent retains its heat conductivity of approximately 0.4 B.t.u. per hour, per square foot, per degree F., per inch over a temperature range from 0 to 600 degrees F.

PRESSURE UNITS CONVERSION TABLE

	lbs. sq. ft.	lbs. sq. in.	Inches of of mercury at 32° F.	Atmospheres at sea level
One pound per square foot	1	0.006944	0.014139	0.0004724
One pound per square inch	144	1	2.03594	0.06802
One ounce per square inch	9	0.0625	0.127246	0.004252
One atmosphere, standard at sea level	2116.1	14.696	29.924	1
One kilogram per square meter	0.2048	0.00142	0.002895	0.000097
One kilogram per square decimeter	20.4817	0.142234	0.289579	0.009678
One gram per square millimeter	204.817	1.42234	2.89579	0.09678
One kilogram per square centimeter	2048.17	14.2234	28.9579	0.9678
Fluid Pressures—				
One foot of water at 39.1 deg. F., maximum density	62.425	0.43350	0.832254	0.029492
One foot of water at 62 deg. F	62.355	0.43302	0.88080	0.029460
One inch of water at 62 deg. F	5.196	0.036085	0.07340	0.002455
One inch of mercury at 32 deg. F. standard	70.7290	0.491174	1	0.033416
One centimeter of mercury at 32 deg. F. standard	27.8462	0.193376	0.393701	0.013158
One foot of air at 32 deg. F., 1 atmosphere pressure	0.08071	0.0005604	0.0011412	0.00003813
One foot of air at 62 deg. F	0.07607	0.00052582	0.0010755	0.00003594

PRESSURE CONDITIONS IN VARIOUS PARTS OF THE WORKS

	Pressure	Differential Pressure
Retorts	Level gauge	
Hydraulic main	½ to 1-inch vacuum	3-inch, approx.
High vacuum main	4-inch vacuum	
Exhauster inlet	7 " "	
Exhauster outlet	32-inch pressure	
Tar extractor outlet	28 " "	4 " "
Washers outlet	26 " "	2 " "
Scrubbers outlet	24 " "	2 " "
Purifiers outlet	10 " "	14 " "
Station meter outlet	9.5 " "	0.5 " "
Holder	9 " "	9 " "

It should be noted that the figures given above merely indicate approximate pressures in the works. The actual pressures that occur in any particular works depend upon a great variety of factors, but it may be stated here that a daily record of differential pressures across the various pieces of plant on the works gives an indication of the condition of those parts of the gas works equipment.

THERMAL VALUE OF GASES IN DIFFERENT UNITS

	1	2	3	4
Carbon (amorphous)	14,600	8,110	....	....
Carbon to CO	4,360	2,420	....	....
Carbon monoxide (CO)	4,390	2,440	420	3,050
Hydrogen, gross	61,300	34,050	320	3,060
Hydrogen, net	51,500	28,600	269	2,570
Methane (CH_4), gross	23,920	13,290	998	9,530
Methane (CH_4), net	21,510	11,950	897	8,560
Ethylene, gross	21,310	11,840	1,580	15,080
Ethylene, net	19,890	11,050	1,475	14,080
Benzene, gross	18,000	10,000	3,650	34,800
Benzene, net	17,250	9,590	3,500	33,400
Napthalene, gross	17,390	9,660	5,910	56,400
Napthalene, net	16,940	9,430	5,770	55,100
Sulphuretted hydrogen, gross	7,020	3,900	624	5,940
Sulphuretted hydrogen, net	6,440	3,580	571	5,450
Sulphur	4,000	2,220	....	....
Pyrites	3,300	1,820	....	....
Acetylene	20,990	11,660	....	....
Gasoline, gross	20,100	11,170	....	....
Gasoline, net	18,500	10,280	....	....
Alcohol, 90 per cent, gross	11,100	6,170	....	....
Alcohol, 90 per cent, net	10,100	5,610	....	....
Fuel oil (Persian), gross	19,300	10,720	....	....
Fuel oil (Persian), net	18,200	10,110	....	....

NOTE—1. B.t.u. per lb.
2. Calories per kgm. = (1) ÷ 18.
3. B.t.u. per cu. ft. 60° and 30″ (moist).
4. Calories per cubic meter at 0° C. and 760 mm. (dry).

VOLUME AND WEIGHT UNITS CONVERSION TABLE

TO CONVERT FROM \ MULTIPLY BY	To Cu. In.	To Cu. Ft.	To Cu. Yd.	To Fl. Oz.	To Pint	To Quart	To Gal.	To Grain	To Oz. Troy	To Oz. Av.	To Lb. Troy	To Lb. Av.	To CC. or G.	To Ltr. or Kg.	To Cu. M.
Cu. in.	1.00000	.0₃5787	.0₄2143	.554112	.034632	.017316	004329	252 891	526857	.578037	.043905	036127	16.3871	.016387	.0₄1639
Cu. Ft.	1728.00	1.00000	.037037	957.505	59.8442	29.9221	7.48052	436996	910.408	998 848	75 8674	62 4280	28316 9	28 3169	028317
Cu. Yd.	46656.0	27.0000	1.00000	25852.6	1615 79	807.896	201.974	117990₃	24581.0	26968.9	2048.42	1685.56	764556	764.556	764556
Fl. Oz.	1.80469	.001044	.0₄3868	1.00000	.062500	.031250	.007813	456.390	.950813	1 04318	.079234	.065199	29 5736	029573	.0₄2957
Pint	28.8750	.016710	.0₃6189	16.0000	1.00000	.500000	.125000	7302.23	15.2130	16.6908	1.26775	1.04318	473 177	.473177	.0₃4732
Quart	57.7500	.033420	.001238	32.0000	2.00000	1.00000	.250000	1460.45	30.4260	33.3816	2.53550	2.08635	946 354	.946354	.0₃9463
Gallon	231.000	.133681	.004951	128.000	8.00000	4.00000	1 00000	58417.9	121.704	133.527	10.1420	8 34541	3785.42	3.78542	003785
Grain	.003954	.0₅2288	.0₇8475	.002191	.0₃1369	.0₄6850	.0₄1712	1.00000	.002083	.002286	.0₃1735	0₃1428	.064799	0₄6479	0₇6479
Oz. Troy	1.89805	.001098	.0₄4068	1.05173	.065733	.032867	.008217	480.000	1.00000	1.09714	.083333	.068571	31.1035	.031104	.0₃3110
Oz. Av.	1.72999	.001001	.0₄3708	.958608	059913	.029957	.007489	437.500	.911457	1.00000	075955	.062500	28.3495	.028350	.0₄2835
Lb. Troy	22.7766	.013181	.0₃4882	12.6208	.788800	.394400	.098600	5760.00	12.0000	13.1657	1.00000	.822857	373.242	.373242	0₃3732
Lb. Av.	27.6799	.016018	.0₃5933	15.3378	.958611	.479306	.119826	7000.00	14.5833	16.0000	1.21528	1.00000	453.593	.453593	.0₃4536
CC. or Gram	.061024	.0₄3531	.0₅1308	.033814	.002113	.001057	.0₃2642	15.4323	.032151	.035274	.002679	.002205	1.00000	.001000	.000001
Liter	61.0237	.035315	.001308	33.8140	2.11337	1.05669	.264172	15432.3	32.1507	35.2739	2 67923	2.20462	1000.00	1.00000	.001000
Cu. M.	61023.7	35.3146	1.30795	33814.0	2113.37	1056.69	264.172	154320₃	32150.7	35273.9	2679.23	2204.62	1000000	1000.00	1.00000

Note.—The small subnumeral following a zero indicates that the zero is to be taken that number of times; thus, .0₃1428 is equivalent to 0001428.

Values used in constructing table:
1 inch=2.540001 cty.
1 cu. in.=16,387083 cc.=16.387083 g H_2O at 4°C=39°F
1 lb. av.=453.5926 g.
∴ 1 gal.=8.34541 lb.
∴ 1 lb. av.=27.679886 cu. in. H_2O at 4°C.
1 lb. av.=7000 grains.
∴ 1 gallon=58417.87 grains.
231 cu. in.=1 gallon=3785.4162 g.

AVERAGE WEIGHT OF VARIOUS COALS

Coal	Per cu. ft. Solid	Per cu. ft. heaped	Cu. ft. per ton heaped	Per cu. yd. Solid
Anthracite	84.5 lbs.	58.3 lbs.	38.4 cu. ft.	2,160 lbs
Bituminous	78.3	49.8	45.3	2,100
Cannel	76.8	48.3	46.4	2,190
Coal as stored				1,150

WATER GAS

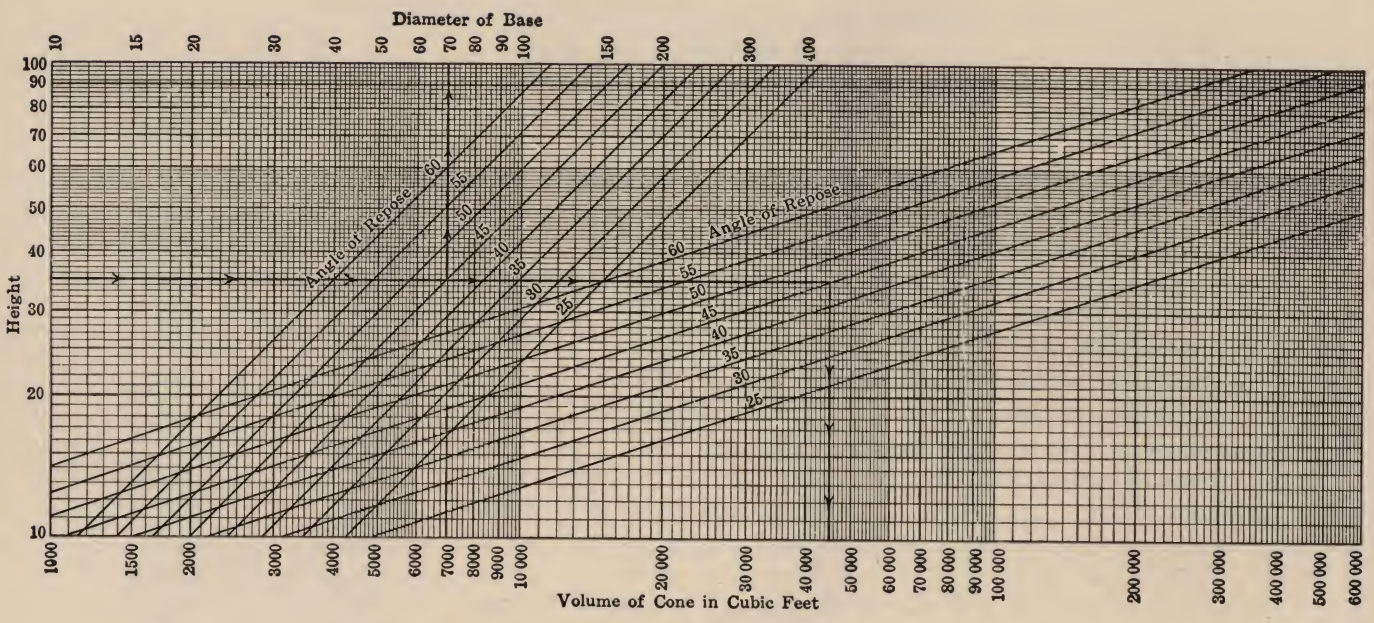
TYPICAL BACKRUN OPERATING RESULTS

Size of set, diameter of generator, feet	6	11	11	7
Fuel	Coke	Gas Coke	Coke	Subbituminous
Cycle, Blow, minutes	4.2	2.38	1.83	2.5
Up-run, minutes	2.0	2.97	1.95	2.0
Back-run, minutes	2.0	1.43	1.88	2.0
Blow-run, minutes	0.0	0.13	0.00	0.5
Temperature, Top of superheater, °F	...	1300	1100	1200
Base of carburetter, °F	...	1450	1350	1475
Oil used, Field	Okla.	Okla.	Texas	Calif.
Gravity, degrees Bé	34.36	32.36	35	24.26
Gallons per M	2.88	2.58	2.78	3.34
Carburetted blue gas, B.t.u. per cubic foot	570	519	530	519
Generator fuel, pounds per M	30.83	28.81	27.0	52.91
Period covered by results, months	6	2	5	12
Oil efficiency,* B.t.u. per gallon	111,700	102,700	100,700	83,500

* In case number 1, efficiency $= \dfrac{1000\ (570—300) + (2.88 \times 60 \times 300)}{2.88} = 111{,}700$

HEAT BALANCE OF CARBURETTED BLUE GAS PROCESS

Imput	Per Cent	Per Cent	Output	Per Cent	Per Cent
Heating value of coke or anthracite	57.3	40.1	Heating value in ash and dust	4.0	1.5
Heating value of oil	38.5	55.8	Sensible heat in ash and dust	0.2	0.1
Sensible heat in air	0.1	0.2	Undetermined (radiation, carbon deposits, etc.)	3.7	7.0
Total heat in steam	4.1	3.9			
Total imput	100.0	100.0	Total output	100.0	100.0
Output			B.t.u. per cu. ft. of gas made.	485	656
Heating value of gas made	60.2	68.1	Temperature of blast gases leaving set, °F	1340	1280
Sensible heat in gas	4.0	3.3	Temperature of make gas leaving set, °F	1330	1280
Total heat of undecomposed steam	1.9	4.0	Fusel used	Coke	Anthracite
Heating value of tar	6.5	8.8	Size of set, internal diameter of generator, ft	7 or 8	6
Sensible and latent heat in tar	0.3	0.5			
Sensible heat in blast gases	12.9	6.6			
Heat of CO in blast gases	6.3	0.1			



To Find Diameter of Base and Volume of a Cone

Enter chart at the left with height of cone, following across until the first set of lines giving angle of repose of the material is reached and read directly above at the top of the chart the diameter of the base. Continue along the first line giving height of cone until the second set of lines giving angle of repose is reached and read directly below the volume in cubic feet of the given cone.

The heavy line indicates that a cone 35′ high, with an angle of repose of 45°, will have a base diameter of 70′ and a volume of 45,000 cu. ft.

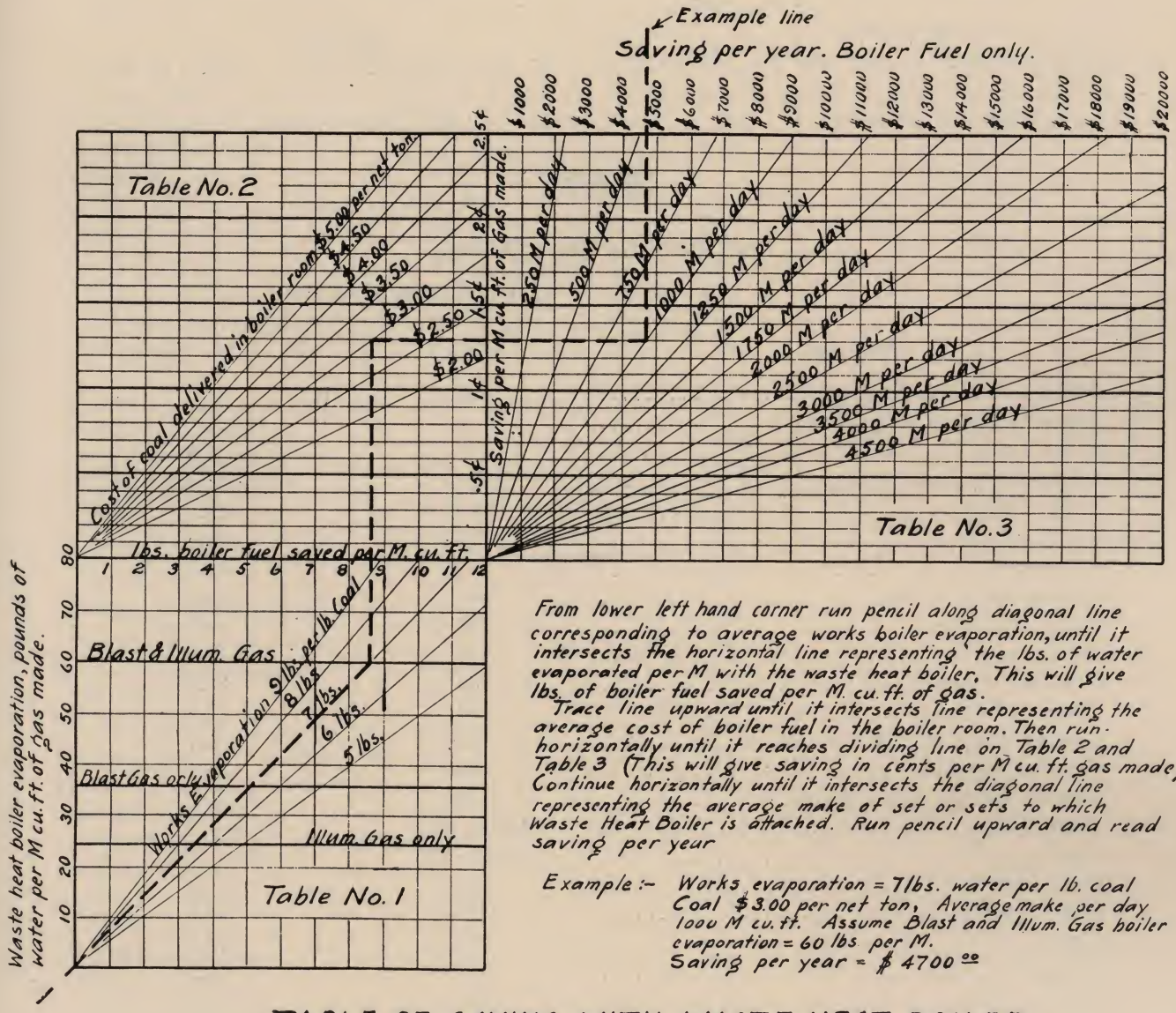
The above operations may be reversed to find height of a cone to give any required volume.

Frustums of cones may also be calculated by finding the volume of the full cone, and the upper section, and subtracting the latter from the first.

ENERGY UNITS CONVERSION TABLE

TO CONVERT FROM	MULTIPLY BY										
	B. T. U.	P. C. U.	Cal.	Ft. Lbs.	Ft. Tons	Kg. M.	HP. Hrs.	KW Hrs.	Joules	Lbs. C.	Lbs. H_2O
B. T. U.	1.00000	.555556	.251996	778.000	.389001	107.563	.0₂3929	.0₂2931	1055.20	.0₄6876	.001031
P. C. U.	1.80000	1.00000	45.3593	1400.40	.700202	193.613	0₂7072.	.0₂5276	1899.36	.0₃1238	.001855
Calories	3.96832	2.20462	1.00000	3091.36	1.54368	426.844	.001559	.001163	4187.37	.0₂2729	.004089
Ft. Lbs.	001285	.0₃7141	.0₃3239	1.00000	.000500	.138255	.0₆5050	.0₆3767	1.35625	.0₇8840	.0₄1325
Ft. Tons	2.57069	1.42816	.647804	2000.00	1.00000	276.511	.001010	.0₂7535	2712.59	.0₃1768	.002649
Kg. M.	009297	.005165	.002343	7.23301	.003617	1.00000	.0₃3653	.0₂2725	9.81009	.0₄6394	.0₃9580
HP Hrs.	2544.99	.141388	641.327	1980000	990.004	273747	1.00000	.746000	2685473	.175044	2.62261
KW Hrs.	3411.57	1895.32	859.702	2654200	1327.10	366959	1.34041	1.00000	3599889	.234648	3.51562
Joules	.0₃9477	.0₃5265	.0₃2388	.737311	.0₃3687	.101937	.0₆3724	.0₆2778.	1.00000	.0₇6518	.0₄9766
Lbs. C.	14544.0	8080.00	3665.03	113150₃	5657.63	1564396	5.71434	4.26285	153470₃	1.00000	14.9876
Lbs. H_2O	970.400	539.111	244.537	754971	377.487	104379	.381270	.284424	1023966	.066744	1.00000

"P. C. U." refers to the "pound-centigrade unit." The ton used is 2000 pounds. "Lbs. C" refers to pounds of carbon oxidized, 100% efficiency equivalent to the corresponding number of heat units. "Lbs. H_2O" refers to pounds of water evaporated at 100°C.=212°F. at 100% efficiency.



From lower left hand corner run pencil along diagonal line corresponding to average works boiler evaporation, until it intersects the horizontal line representing the lbs. of water evaporated per M with the waste heat boiler. This will give lbs. of boiler fuel saved per M. cu. ft. of gas.

Trace line upward until it intersects line representing the average cost of boiler fuel in the boiler room. Then run horizontally until it reaches dividing line on Table 2 and Table 3 (This will give saving in cents per M cu. ft. gas made) Continue horizontally until it intersects the diagonal line representing the average make of set or sets to which Waste Heat Boiler is attached. Run pencil upward and read saving per year

Example:– Works evaporation = 7 lbs. water per lb. coal Coal $3.00 per net ton, Average make per day 1000 M cu. ft. Assume Blast and Illum. Gas boiler evaporation = 60 lbs per M. Saving per year = $4700.00

TABLE OF SAVING WITH WASTE HEAT BOILER.

PROPORTION OF CHIMNEYS

Diameter of base, one-tenth height.

Brickwork 9 inches thick for the top 25 feet.

Brickwork 14 inches thick from 25 to 50 feet from the top.

Brickwork 18 inches thick from 50 to 75 feet from the top.

Brickwork 23 inches thick from 75 to 100 feet from the top.

Increasing 4½ inches thick for every extra 25 feet.

Rule for Area of Chimney if 21 lbs. of Coal Are Consumed Per Square Foot Grate Area Per Hour

Area of firegrate, in square feet, × 1½ ÷ $\sqrt{\text{height in feet}}$ = area in square feet.

Or, one-eighth to one-tenth grate area = area of chimney.

DRAFT OF CHIMNEYS

1 cubic foot air at 30" Bar. and 60° F. = 0.0763 lbs. and varies as absolute temperature. Ten if chimney gases are at 550° F.

$$\frac{0.0763 \times (460 + 60)}{460 + 550} = 0.0393$$

0.0763 — 0.0393 = 0.037 lbs. per foot height per square foot area of chimney or height of chimney for 1″ draft in feet

$$\frac{5.21\ (= \text{lbs. per sq. ft. of } 1'' \text{ pressure})}{0.037} = 141$$

Or, approximately—draft in inches of water = 0.0075 × height of chimney. Then 0.0075 × 141 — 1.0575 inches draught.

WEIGHT OF MATERIALS

Materials	Weight of one Cubic Foot in lbs.	Cubic Feet per Ton (2,000 lbs.)
Ashes	37	54
Ashes 52 feet = 1 chaldron	...	...
Brass, Cast	524	3.8
Brick, Fire Clay	125-140	16.0—14.3
Brick, Silica	105	19.1
Brick, Chrome	175	11.4
Brickwork	100	20
Brickwork in cement	110	18.2
Bricks, red kiln	135	14.8
Bricks, common	110	18.2
Cement, Hydraulic	60	33.3
Cement, Portland	84	23.8
Cement, Portland cask 4 bushels =	5 feet	2 cwt.
Cement, Roman	60	33.4
Cement, Roman cask 5 bushels =	6 feet	4 cwt.
Chalk	140 to 166	14.3—12.1
Clay	120 to 135	16.7—14.8
Coal, Anthracite	60	33.3
Coal, Bituminous	49	40.8
Coke	47	42.5
Concrete	120	16.7
Copper, Cast	537	3.8
Earth	95 to 126	21.0—15.9
Fire Clay	85	23.5
Flint	164	12.2
Glass, Crown	157	12.7
Glass, Flint	187	10.7
Glass, Plate	184	20.4
Granite	165	12.1
Gravel	112 to 120	17.9—16.7
Gypsum	143	14.0
Iron, cast	450	4.45
Iron, wrought	487	4.1
Lead, Cast	708	2.8
Limestone	53	37.8
Lime, chalk	44	45.5
Lime, Quick, Loose Lumps	53	37.8

Materials	Weight of one Cubic Foot in lbs.	Cubic Feet per Ton (2,000 lbs.)
Lime, Quick, Fine	75	26.8
Magnesia Cement	127	15.7
Marble	...	11.2—11.6
Masonry Granite or Limestone	165	12.1
Masonry, Mortar, Rubble	154	13.0
Masonry, Dry	138	14.5
Masonry, Sandstone, Dressed	144	13.9
Mortar, from (old)	88	22.7
Mortar, to (new)	119	16.8
Oil, Crude	48	41.6
Oil, Engine	55	36.4
Oil of Linseed	58¾	34.5
Oil of Turpentine	54¾	37
Oil of Whale	57¾	35.1
Quartz	165	12.1
Rain Water (252 gallons per ton)	62½	32.2
Sand, Dry and Loose	100	20.0
Sand, Dry and Packed	110	18.2
Sand, Wet and Packed	130	15.4
Sand, Gravel Packed	118	16.9
Sand, pit	90	22.2
Sand, river	118	16.9
Sea Water (224 gallons per ton)	64	31.2
Shales	162	12.3
Silica Cement	75	26.8
Slate, American	175	11.4
Steel, Cast	490	4.1
Steel, Rolled	495	4.0
Stone, Granite	...	12.1
Tiles, average	112	17.9
Water, as Ice	58.7	34.2
Water, at 32° F	62.4	32.0
Water, at 212° F	59.6	33.6
Woods:		
Beech	43	46.5
Cedar, American	35	57.1
Chestnut	41	48.8
Elm	35	57.1
Maple	49	40.8
Oak, Live	59	33.9
Oak, White	50	40.0
Pine, White	25	80.0
Pine, Yellow Northern	34	58.8
Pine, Yellow Southern	45	44.5
Spruce	25	80.0

PRINCIPAL PROPERTIES OF GAS COMPONENTS

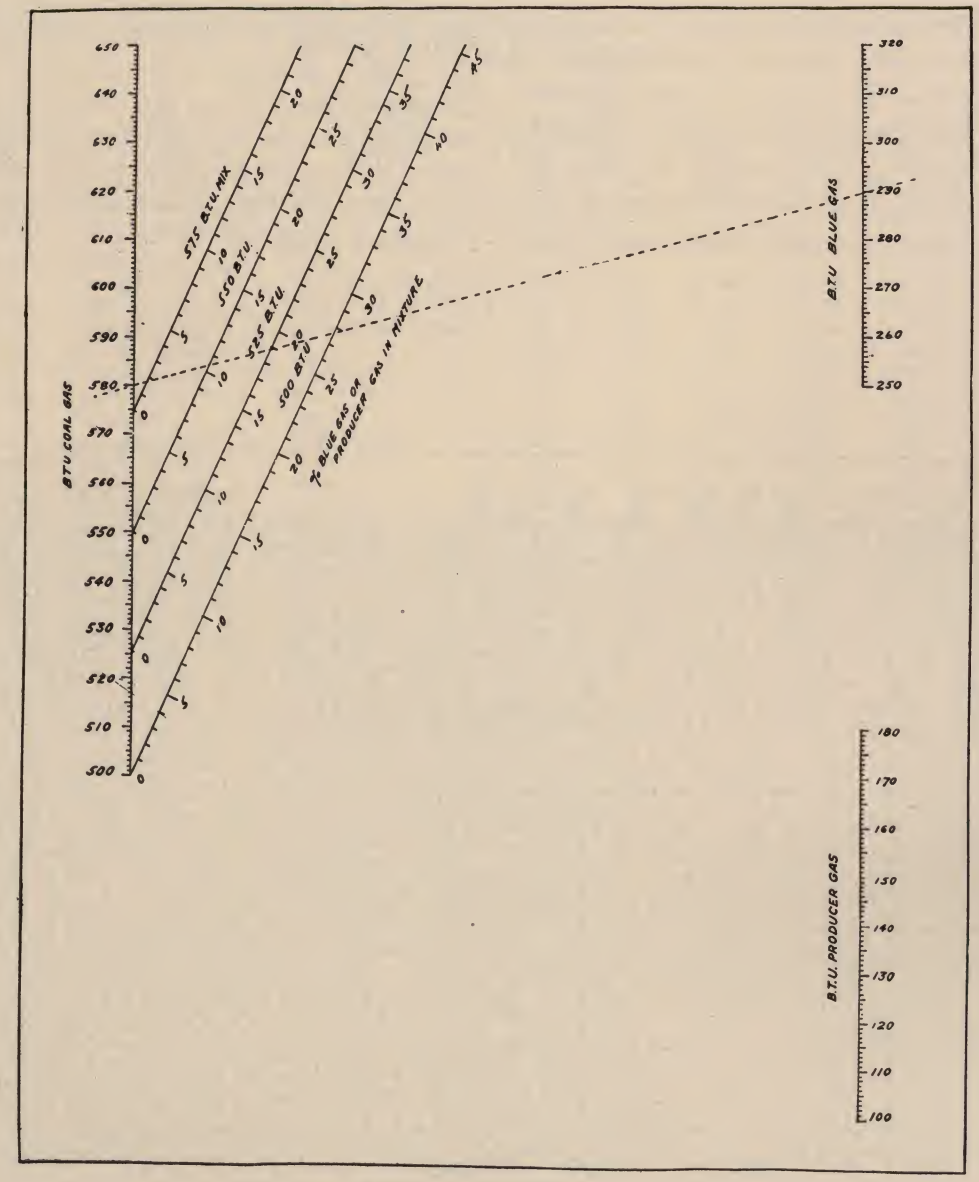
	Air	Carbon Dioxide	Oxygen	Carbon Monoxide	Ethylene	Benzene	Methane	Hydrogen	Nitrogen	Aqueous Vapor
1. Name	Air	Carbon Dioxide	Oxygen	Carbon Monoxide	Ethylene	Benzene	Methane	Hydrogen	Nitrogen	Aqueous Vapor
2. Formula	..	CO_2	O_2	CO	C_2H_4	C_6H_6	CH_4	H_2	N_2	H_2O
3. Specific gravity (air = 1) dry	1	1.5290	1.1055	0.9674	0.985	2.694	0.555	0.06952	0.9674	0.6212
4. Grams per liter 0° C. and 760 mm., dry	1.2929	1.9768	1,4291	1.2505	1.274	3.482	0.717	0.08987	1.2507	(0.8031)
6. Lbs. per 1,000 cu. ft., 60° F. and 30", moist	76.04	117.01	84.61	74.04	75.43	206.2	42.45	5.321	74.05	(47.55)
5. Lbs. per 1,000 cu. ft., 60° F. and 30", dry	76.54	115.81	83.98	73.58	74.95	203.5	42.54	6.050	73.59	....
7. B.t.u. per cubic foot, 60° F. and 30" (moist), gross	Nil	Nil	Nil	320	1,580	3,650	998	320	Nil	Nil
8. B.t.u. per cubic foot, 60° F. and 30" (moist), net				320	1,475	3,500	897	269		
9. Mean specific heat, calories per cubic meter, 0° to 200° C.	0.310	0.413	0.310	0.310	....	....	0.310	0.310	0.310	0.386
10. Mean specific heat, calories per cubic meter, 0° to 2,000° C.	0.358	0.710	0.358	0.358	....	....	0.352	0.358	0.358	0.619
11. Ignition temperature, °C. (M. David)	....	....	....	931	1,000	....	1,000	747	....	....
12. Flame, temperature, °C.	....	....	....	2,100	....	....	1,830	1,960	....	....
13. Relative flame radiation	....	....	....	180	510	....	330	75	....	....
14. Explosive limits, per cent, in air	....	....	....	16.6-74.8	4.2-14.5	2.7-6.3	6.2-2.7	9.5-66.3	....	....
15. Percentage effect on coal gas, of 1 per cent, on C. V.	—1	—1	—1	—0.4	+1.8	+6.0	+0.8	—0.5	—1	—1
16. Percentage effect on coal gas, of 1 per cent, on I. P. (rgand)	—2.7	—3.5	—3.0	—0.9	+10.9	+18.0	—0.4	—0.5	—2.6	....
17. Percentage effect on coal gas, of 1 per cent, on I. P. (incandescent)	....	(?)—2.2	....	....	....	....	....	....	—1.4	....
18. Volumes of air for complete combustion	....	....	....	2.38	14.29	35.7	9.52	2.38	....	....
19. C. V. of mixture, B.t.u., net per cubic foot (60° and 30", moist)	....	....	....	94.7	96.5	95.3	85.2	79.6	....	....

PROPORTIONAL MIXING OF GAS

The chart on the opposite page may be used for the purpose of determining the proportions of blue gas or producer and coal gas in a mixed gas of given B.t.u. value per cubic foot, where the thermal values of the producer gas or blue gas, and of the coal gas are given in B.t.u. per cubic foot.

For example, the blue gas has a thermal value of 290 B.t.u. per cubic foot and the coal gas a thermal value of 580 B.t.u. per cubic foot. Locate these points on their respective scales and connect them by straight line (shown in figure). The point of intersection of this line with the 500 B.t.u. per cubic foot thermal value of the mixed gas shows that this mixed gas must contain 27.8 per cent blue gas, if the B.t.u. value of the mixed gas is to be 500 B.t.u. per cubic foot. Other scales are given for mixed gas of different thermal value. A producer gas scale is also included.

There are other ways of using this chart to solve problems in mixing gases. Thus, suppose a 525 B.t.u. per cubic foot mixed gas is desired and it is calculated that enough coal gas at 580 B.t.u. per cubic foot thermal value is available to give a mixture containing 81 per cent of coal gas, leaving 19 per cent for water gas. What is the required B.t.u. per cubic foot of the water gas to fulfill these requirements? The point 580 is found on the Coal Gas Scale and the point of 19 per cent on the 525 B.t.u. mixed gas scale. These two points are joined by a straight line which is then prolonged until it cuts the Blue Gas Scale. The point of intersection is determined to be at 290 B.t.u. per cubic foot, which is the required thermal value of the blue gas.



STEAM VELOCITY, PRESSURE AND PIPE SIZE

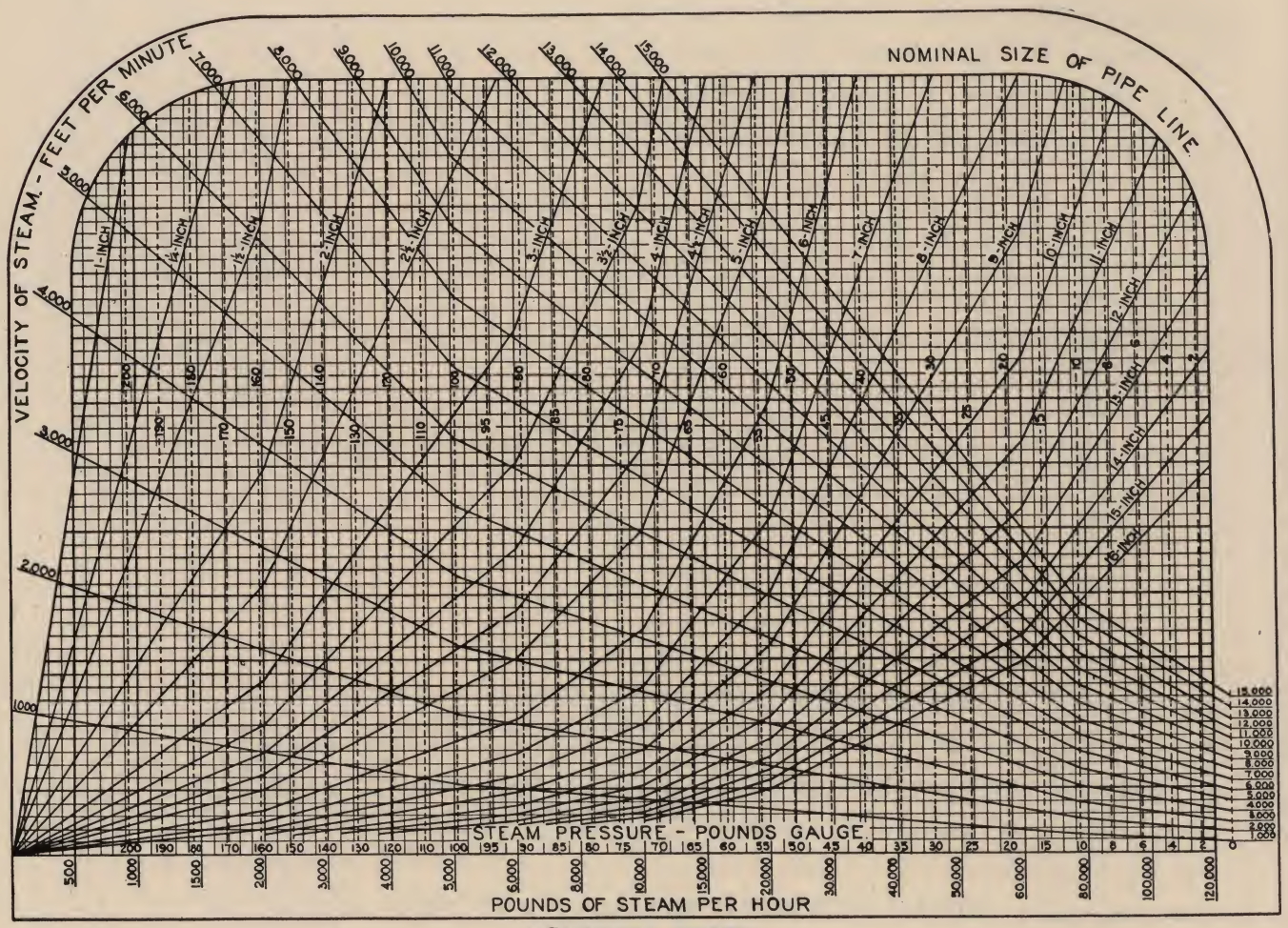
The accompanying curve is used in the following manner:

It is assumed that the velocity of the steam is 5,000 feet per minute and it is required to find the size of pipe that will be required to deliver 8,000 pounds of steam at a pressure of 120 gauge. The 5,000 foot velocity line is traced to the 120 pounds gauge pressure. From the intersection a line is drawn horizontally to the 8,000 pounds of steam per hour

vertical. The intersection is then read according to the nearest pipe size curve, which is four inches.

A six-inch pipe delivers 20,000 pounds of steam per hour at 85 pounds gauge pressure. What is the velocity of the steam? Trace the line representing 20,000 pounds of steam per hour vertically upwards to intersect the six-inch pipe curve; then follow horizontally to 85 pounds of steam pressure and read 7,350 feet from the velocity scale.

If the velocity of the steam is 6,000 feet per minute through an eight-inch pipe, what are the pounds of steam delivered at 100 pounds gauge pressure? Trace the 6,000 feet velocity line until it intersects the 100 pounds pressure line. Follow horizontally to the eight-inch pipe curve and then read at that point 32,300 pounds of steam per hour.



VELOCITY CHART

American Gas Catalog and Handbook

COKE OVEN GAS

AVERAGE TEMPERATURES AND PRESSURES OF GAS THROUGHOUT THE COKE OVEN PROCESS

Name of Equipment	Function of Equipment	Medium Affecting Conditions	—Temperature in Deg. F.— Before	After	Change	Pressure in Inches of Water Before	After	Change
Oven	Making the gas	Heat	68	1112	+1044	+ 0.28	+ 0.16	— 0.12
Oven standpipe	Removing gas from oven	Radiation to air	1112	752	— 360	+ 0.16	+ 0.12	— 0.04
Collecting main	Collects gas from all ovens	Liquor flushing	752	356	— 153	+ 0.12	+ 0.10	— 0.02
Cross-over main	Transports gas from ovens	Liquor flushing radiat'n	356	347	+ 342	+ 0.10	— 1.72	— 1.82
Suction main	Takes gas to coolers	Liquor flushing radiat'n	347	338	— 99	— 1.72	— 3.20	— 1.48
Down-comers	Collects tar flushing	Liquor flushing radiat'n	338	167	— 54	— 3.20	— 5.20	— 2.00
Primary coolers	Cools gas indirectly	Water	167	82	— 85	— 5.20	— 8.00	— 2.80
Exhausters	Produces gas flow	Compression	82	91	+ 9	— 8.80	+72.0	+80.8
Tar extractors	Removes tar from gas	Tar	91	97	+ 6	+72.0	+64.0	— 8.0
Reheaters	Reheats gas	Steam	97	131	+ 34	+64.0	+62.0	— 2.0
Saturators	Extracts ammonia	Acid solution	131	136	— 5	+62.0	+32.0	—30.0
Final cooler	Cools gas directly	Water	136	79	— 57	+28.0	+24.0	— 4.0
First scrubber	Extracts light oils	Wash oil	79	86	+ 7	+24.0	+21.6	— 2.4
Second scrubber	Extracts light oils	Wash oil	86	91	+ 5	+20.0	+18.4	— 1.6
Third scrubber	Extracts light oils	Wash oil	91	95	+ 4	+17.6	+16.8	— 0.8
Plant holder	Reservoir for gas	Water	95	93	— 2	+16.8	+16.8	— 0
Fuel gas line	Takes gas to ovens	Ground	93	91	— 2	+16.8	+12.0	— 4.8
Booster	Pumps gas to distribution line	Compression	86	140	+ 54	+10.0	+ 4 lbs.	+ 4.3 lbs.
Fuel gas line	Gas entering manifold	Radiation	86	91	+ 5	+12.0	+ 28.0	—11.72

CONVERSION FACTORS

To Convert	To	Multiply by
Atmospheres	Kilogrammes per square centimeter	1.033
Atmospheres	Pounds per square inch	14.7
Brake horsepower hours	B.t.u.	2,545
B.t.u. (electric)	B.t.u.	3,415
B.t.u's.	Foot—pounds	788
Calories	B.t.u.	3.968
Calories per cubic meter °C., 30"	B.t.u's. per cubic foot, °C., 30"	0.1124
Calories per cubic meter °C., 30"	B.t.u's. per cubic foot, 60° 30"	0.1049
Calories per kilogram	B.t.u. per pound	1.8
Centigrade degrees	Fahrenheit, degrees	1.8 and add 32
Cubic feet	Gallons	6.23
Cubic feet	Liters	28.32
Cubic meters	Cubic feet	35.31
Fahrenheit degrees	Centigrade, degrees	Subtract 32 and divided by 1.8
Gallons	Liters	4.546
Gallons, 10 oz. liquor	Pounds sulphate	0.843
Grams per cubic meter	Grains per 100 cubic feet	4.37
Grams	Grains	15.43
Inches, mercury gauge	Inches, water gauge	13.6
Inches, water gauge	Pounds per square inch	0.036
Kilogram	Pounds	2,205
Meters	Inches	39.37
Ounces (avoirdupois	Grams	28.35
Pounds	Grains	7,000
Pounds per square inch	Kilogrammes per square centimeter	0.0703
Sulphuretted hydrogen per cent volume	Grains S per 100 cubic feet	586
Therms	B.t.u. (electric)	29.28
Volume of Gas—	60° F. and 30" (dry)	1.054
0° C. and 760 mm. (dry)	60° and 30" (moist)	1.073
Grams per cu. meter at 0° C. and 760 mm. (dry)	Pounds per 1,000 cu. ft. at 60° F. and 30" (dry)	59.21

DECIMAL EQUIVALENTS FOR FRACTIONS OF INCH AND FOOT

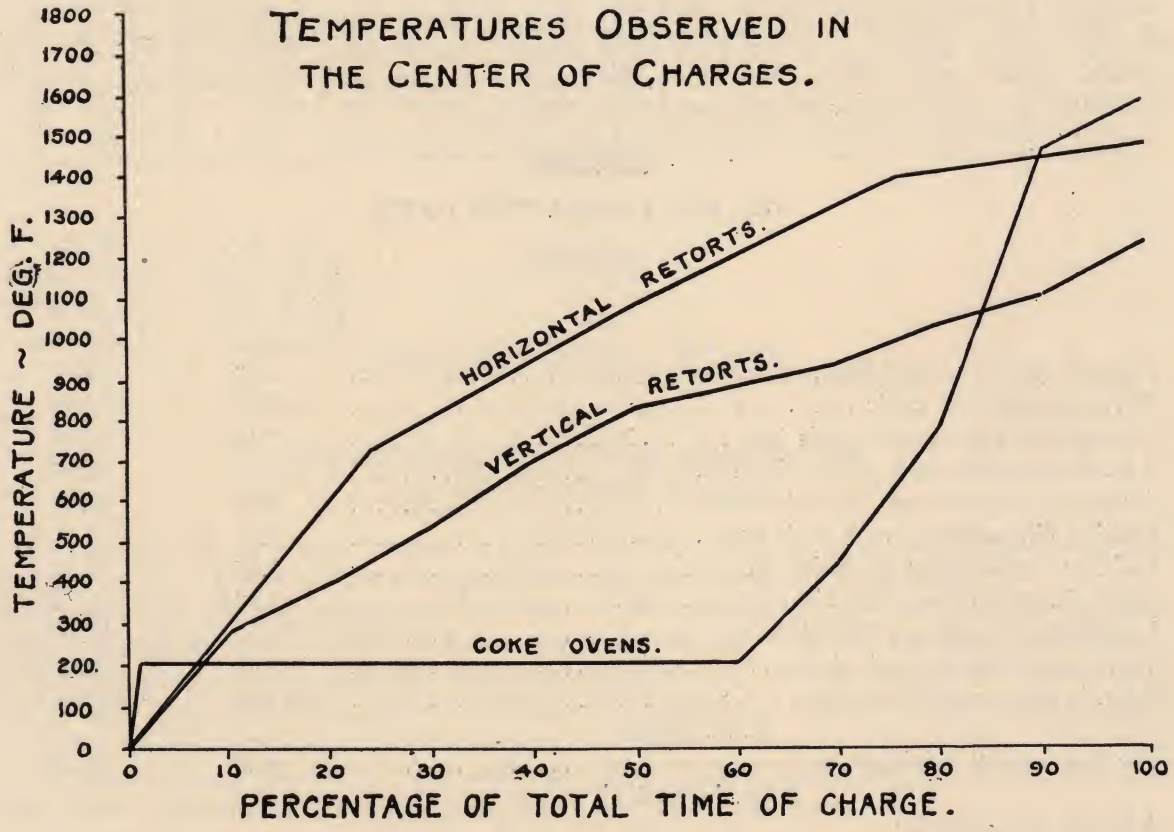
Fractions of Inch or Foot	Inch Equivalents to Foot Fractions	Fractions of Inch or Foot	Inch Equivalents to Foot Fractions	Fractions of Inch or Foot	Inch Equivalents to Foot Fractions	Fractions of Inch or Foot	Inch Equivalents to Foot Fractions	Fractions of Inch or Foot	Inch Equivalents to Foot Fractions	Fractions of Inch or Foot	Inch Equivalents to Foot Fractions
.0052	1/16	11/64 .171875	2 1/16	11/32 .34375	4 1/8	33/64 .515625	6 3/16	11/16 .6875	8 1/4	55/64 .859375	10 5/16
.0104	1/8	.1771	2 1/8	.3490	4 3/16	.5208	6 1/4	.6927	8 5/16	.8646	10 3/8
		.1823	2 3/16	.3542	4 1/4	.5260	6 5/16	.6979	8 3/8	.8698	10 7/16
1/64 .015625	3/16			23/64 .359375	4 5/16	17/32 .53125	6 3/8	45/64 .703125	8 7/16		
.0208	1/4	3/16 .1875	2 1/4	.3646	4 3/8	.5365	6 7/16	.7083	8 1/2	7/8 .8750	10 1/2
.0260	5/16	.1927	2 5/16	.3698	4 7/16	.5417	6 1/2	.7135	8 9/16	.8802	10 9/16
		.1979	2 3/8							.8854	10 5/8
1/32 .03125	3/8	13/64 .203125	2 7/16	3/8 .3750	4 1/2	35/64 .546875	6 9/16	23/32 .71875	8 5/8	57/64 .890625	10 11/16
.0365	7/16	.2083	2 1/2	.3802	4 9/16	.5521	6 5/8	.7240	8 11/16	.8958	10 3/4
.0417	1/2	.2135	2 9/16	.3854	4 5/8	.5573	6 11/16	.7292	8 3/4	.9010	10 13/16
3/64 .046875	9/16	7/32 .21875	2 5/8	25/64 .390625	4 11/16	9/16 .5625	6 3/4	47/64 .734375	8 13/16	29/32 .90625	10 7/8
.0521	5/8	.2240	2 11/16	.3958	4 3/4	.5677	6 13/16	.7396	8 7/8	.9115	10 15/16
.0573	11/16	.2292	2 3/4	.4010	4 13/16	.5729	6 7/8	.7448	8 15/16	.9167	11
1/16 .0625	3/4	15/64 .234375	2 13/16	13/32 .40625	4 7/8	37/64 .578125	6 15/16	3/4 .7500	9	59/64 .921875	11 1/16
.0677	13/16	.2396	2 7/8	.4115	4 15/16	.5833	7	.7552	9 1/16	.9271	11 1/8
.0729	7/8	.2448	2 15/16	.4167	5	.5885	7 1/16	.7604	9 1/8	.9323	11 3/16
5/64 .078125	15/16	1/4 .2500	3	27/64 .421875	5 1/16	19/32 .59375	7 1/8	49/64 .765625	9 3/16	15/16 .9375	11 1/4
.0833	1	.2552	3 1/16	.4271	5 1/8	.5990	7 3/16	.7708	9 1/4	.9427	11 5/16
.0885	1 1/16	.2604	3 1/8	.4323	5 3/16	.6042	7 1/4	.7760	9 5/16	.9479	11 3/8
3/32 .09375	1 1/8	17/64 .265625	3 3/16	7/16 .4375	5 1/4	39/64 .609375	7 5/16	25/32 .78125	9 3/8	61/64 .953125	11 7/16
.0990	1 3/16	.2708	3 1/4	.4427	5 5/16	.6146	7 3/8	.7865	9 7/16	.9583	11 1/2
.1042	1 1/4	.2760	3 5/16	.4479	5 3/8	.6198	7 7/16	.7917	9 1/2	.9635	11 9/16
7/64 .109375	1 5/16	9/32 .28125	3 3/8	29/64 .453125	5 7/16	5/8 .6250	7 1/2	51/64 .796875	9 9/16	31/32 .96875	11 5/8
.1146	1 3/8	.2865	3 7/16	.4583	5 1/2	.6302	7 9/16	.8021	9 5/8	.9740	11 11/16
.1198	1 7/16	.2917	3 1/2	.4635	5 9/16	.6354	7 5/8	.8073	9 11/16	.9792	11 3/4
1/8 .1250	1 1/2	19/64 .296875	3 9/16	15/32 .46875	5 5/8	41/64 .640625	7 11/16	13/16 .8125	9 3/4	63/64 .984375	11 13/16
.1302	1 9/16	.3021	3 5/8	.4740	5 11/16	.6458	7 3/4	.8177	9 13/16	.9896	11 7/8
.1354	1 5/8	.3073	3 11/16	.4792	5 3/4	.6510	7 13/16	.8229	9 7/8	.9948	11 15/16
9/64 .140625	1 11/16	5/16 .3125	3 3/4	31/64 .484375	5 13/16	21/32 .65625	7 7/8	53/64 .828125	9 15/16	1 1.0000	12
.1458	1 3/4	.3177	3 13/16	.4896	5 7/8	.6615	7 15/16	.8333	10		
.1510	1 13/16	.3229	3 7/8	.4948	5 15/16	.6667	8	.8385	10 1/16		
5/32 .15625	1 7/8	21/64 .328125	3 15/16	1/2 .5000	6	43/64 .671875	8 1/16	27/32 .84375	10 1/8		
.1615	1 15/16	.3333	4	.5052	6 1/16	.6771	8 1/8	.8490	10 3/16		
.1667	2	.3385	4 1/16	.5104	6 1/8	.6823	8 3/16	.8542	10 1/4		

COMMON CHEMICAL COMPOUND AND PROPERTIES

Name.	Formula.	Molecular Weight.	Composition.	Solubility in 100 Parts.	
				Cold Water.	Boiling Water.
Ammonium chloride	NH_4Cl	53·492	NH_3=·3184	37	73
,, sulphate	$(NH_4)_2SO_4$	132·154	$2NH_3$=·2578	76	98
,, sulphocyanide	NH_4CNS	76·122	S=·4213	122	162
Barium hydroxide	$Ba(OH)_2.8H_2O$	315·514	Ba=·4350	3·5	91 (80°)
,, sulphate	$BaSO_4$	233·44	S=·1374	Insoluble	Insoluble
Calcium carbonate	$CaCO_3$	100·07	CO_2=·4397	·0018	·0088
,, chloride	$CaCl_2.6H_2O$	219·086	....	400	650
,, hydrate	$Ca(OH)_2$	74·086	....	·14	·08
,, sulphate	$CaSO_4.2H_2O$	172·172	....	·24	·22
Carbon bisulphide	CS_2	76·14	S_2=·8424	·2	011 (50° C.)
Copper sulphate	$CuSO_4.5H_2O$	249·72	....	40	203
Ferric ferrocyanide	$Fe_4\{Fe(CN)_6\}_3$	859·06	....	Insoluble	Insoluble
Ferrous sulphate	$FeSO_4.7H_2O$	278·022	....	60	333
Lead acetate	$Pb(C_2H_3O_2)_2.3H_2O$	379·196	....	48	70
Magnesium sulphate	$MgSO_4.7H_2O$	246·502	....	77	671
Mercuric chloride	$HgCl_2$	271·52	....	7·4	54
Naphthalene	$C_{10}H_8$	128·064	....	Insoluble	Insoluble
,, picrate	$C_{10}H_8.C_6H_2(NO_2)_3.OH$	343·108	....	Insoluble	Dissociates
Phenol	C_6H_5OH	94·048	....	6	....
Picric acid	$C_6H_2(NO_2)_3.OH$	215·044	....	....	....
Potassium bichromate	$K_2Cr_2O_7$	294·20	....	12·4	94
,, ferrocyanide	$K_4Fe(CN)_6$	368·30	....	28	100
Silver chloride	$AgCl$	143·34	....	Insoluble	Insoluble
,, nitrate	$AgNO_3$	169·89	....	122	1,111
Sodium carbonate	Na_2CO_3	106·00	....	21·4	45
,, ,, crystals	$Na_2CO_3.10H_2O$	286·16	....	92·8	540
,, chloride	$NaCl$	58·46	Cl=·2474	35	39·5
,, ferrocyanide	$Na_4Fe(CN)_6.10H_2O$	484·06	....	....	....
,, hydroxide	$NaOH$	40·008	....	60	250
,, nitrate	$NaNO_3$	85·01	....	80	200
,, sulphate	$Na_2SO_4.10H_2O$	322·23	....	12·2	412 (34°)
,, sulphite	$Na_2SO_3.7H_2O$	252·182	....	25	100
Sulphuric acid	H_2SO_4	98·086	....	In all proportions.	
Zinc sulphate	$ZnSO_4.7H_2O$	287·552	....	135	655

TEMPERATURE OF CHARGES IN RETORTS AND COKE OVENS

The accompanying chart shows the average temperatures and the variation in the temperature with the time of carbonization for coke ovens, vertical retorts and horizontal retorts. Thus in the case of the coke oven, it is noted that the temperature of the charge remains stationary at 200 degrees F. for practically sixty per cent of the total time of charge. It then rises in four jumps, reaching about 1,660 degrees F. at the end. It is also seen that there are three jumps of temperature in the horizontal retorts and considerably more changes in the temperature in the vertical retorts, or to put it better, more temperature periods within which the temperature increases regularly with the time. On the assumption that the final temperature is attained in a particular retort or coke oven operation and that the standard process is used, it is possible from this curve to estimate the temperature within the charge at various points in the carbonization process.



TESTING STATION METERS FOR LEAKS

Connect up a wet test meter, previously calibrated for absolute accuracy, to the station meter to be tested, so that gas passes through the test meter first, thence to the inlet elbow of the station meter by way of a small connection made for the test. Shut off inlet and outlet valves of station meter, sealing them with water, if practicable, and make small connection in station meter outlet elbow to air.

To test for leaks in the meter case shut off

outlet connection and allow pressure to show in both meters, then shut off inlet of test meter and watch the gauges for a drop in pressure; also watch for a slight rotation of the station meter drum. Should both occur, a leak in the case is indicated; if the former only, a leak somewhere in the connection. Granting the case has proved tight, to test for leaks in the drum, pass gas through both meters at about the rated capacity of the test meter and note any tendency of the station meter to lag in registering the amount of gas passed as shown by the test meter. This will indicate a leak in the drum to be located by taking off the index of the station meter and affixing a long pointer to the stuffing box spindle, which turns with the drum, and throttling the rate of flow of gas until this pointer barely moves, noting where it comes to rest.

This will start to occur when the leak has approached the water level and the drum will probably stop when the leak is at the water level or slightly above it. Take off the head of the meter and look for leak in the body of the drum along the water line, if in the partition some experience with station meters is necessary in locating it.

Readings for temperature of both meters and the pressure should be made at frequent intervals during the test for accuracy of registration at the water line established. These readings are averaged and correction made for difference in temperature between the two meters and at the pressure desired. Barometer corrections are not frequently made in practice.

OIL GAS OPERATING DATA

	14 ft. Single Shell Straight Shot Apparatus	12 ft. Two Shell Improved Apparatus
Average quality of gas, B.t.u. per cubic foot	533	537
Total gas made, M cubic feet	45,463	95,438
Average make per day, M cubic feet	745	1,564
Average operating time per day, hours	14.08	17.25
Average make per hour, M cubic feet	52.9	90.66
Heating oil, gallons per M cubic feet	1.18	0.91
Make oil, gallons per M cubic feet	7.35	6.845
Total oil, gallons per M cubic feet	8.53	7.755
Lampblack, pounds per M cubic feet	20.10	12.57
Tar, pounds per M cubic feet	3.61	3.65
B.t.u. in gas per gallon total oil	62,500	69,245
Per cent overall efficiency $= \frac{\text{B.t.u. in gas}}{\text{B.t.u. in total oil}}$	43.0	47.20
Average gas analysis:		
Carbon dioxide, CO_2	1.3	2.8
Illuminants, C_6H_6 and CnH_2n	4.2	2.7
Oxygen, O_2	0.7	0.1
Carbon monoxide, CO	8.2	10.6
Hydrogen, H_2	54.0	53.5
Methane, CH_4	24.1	27.0
Nitrogen, N_2	7.5	3,3
Totals	100.0	100.0
Calculated B.t.u	529.5	535
Specific gravity	.391	.391

Station Meters

Size	Usual Size of Connections	Customary Water Line		Approx. Capacity in cu. ft. per Single Rev. of Drum		Approx. Capacity per Hour in cu. ft. with 1-inch Loss		Approx. Capacity per 24 Hours in cu. ft. with 1-inch Loss		Weight of Meter	Weight of Water	Weight of Meter and Water
		Old Style	Hinman	Old Style	Hinman	Old Style	Hinman	Old Style	Hinman			
4 ′	8-in.	5¾″	7¾″	23½	26	5,200	8,000	124,800	192,000	3,800	2,200	6,000
4½′	8-in.	6¼″	8½″	36	41	6,800	11,250	163,200	270,000	4,950	3,100	8,050
5 ′	8-in.	7 ″	9½″	53	58½	8,500	14,500	204,000	348,000	5,950	4,200	10,150
5½′	10-in.	7½″	10¼″	71½	80	10,400	18,000	249,600	432,000	7,450	5,650	13,100
6 ′	10-in.	8 ″	11 ″	93	106	12,400	21,750	297,600	522,000	8,750	7,350	16,100
6½′	12-in.	8¾″	12 ″	120	137	14,700	25,750	352,800	618,000	10,500	9,300	19,800
7 ′	12-in.	9¼″	12¾″	149	175	17,100	30,000	410,400	720,000	12,250	11,500	23,750
7½′	12-in.	9¾″	13½″	184	212	19,800	35,000	475,200	840,000	14,350	14,000	28,350
8 ′	12-in.	10¼″	14¼″	224	262	22,500	40,000	540,000	960,000	16,600	17,250	33,850
9 ′	16-in.	11¼″	15¾″	325	378	28,800	51,000	691,200	1,224,000	24,000	24,500	48,500
10 ′	16-in.	12½″	17½″	450	515	36,000	63,000	864,000	1,512,000	29,500	33,500	63,000
11 ′	16-in.	13½″	19 ″	605	695	44,000	77,000	1,056,000	1,848,000	36,000	44,200	80,200
12 ′	16-in.	14¾″	20¾″	795	906	53,000	92,000	1,272,000	2,208,000	44,500	57,500	102,000
13 ′	20-in.	15¾″	22¼″	1022	1170	63,000	109,000	1,512,000	2,616,000	54,000	73,300	127,300
14 ′	24-in.	17 ″	24 ″	1301	1485	74,000	128,000	1,776,000	3,072,000	66,000	91,500	157,500
15 ′	24-in.	18 ″	25½″	1630	1860	86,500	150,000	2,076,000	3,600,000	80,000	112,500	192,500
16 ′	24-in.	19 ″	27 ″	2020	2293	100,000	173,000	2,400,000	4,152,000	95,000	136,000	231,000

NATURAL GAS

MEASUREMENT OF THE VOLUME OR OUTPUT OF GAS WELLS

To measure the volume or output in cubic feet per hour of a gas well or of any orifice discharging gas into the atmosphere the Pitot Tube Gauge is used. Its principle is that the instrument gives the velocity of the current at the point of its application, which velocity, multiplied by the sectional area of the stream, gives the volume of the flow. The simplest form of the instrument is a small tube bent at right angles, the open end of which is inserted in the well mouth at right angles to the flow, and to the opposite end of which is attached a pressure gauge. For convenience the connection may be made with a piece of flexible hose. For wells of light volume, a U water or mercury gauge is used, and if the wells have a strong flow and show a pressure running into pounds, an accurate steam gauge must be used. The open end of the small pipe should be held just below the top of the pipe or flush with it, and at one-fourth of the diameter from the outer edge.

The number of cubic feet per hour that will pass out of a circular opening one inch in diameter at pressure measured by a column of water or mercury, or by a spring gauge, is given in the following tables. The third table contains multipliers for sizes of pipe less and greater than one inch.

For any specific gravity other than 0.6, multiply the result obtained by

$$\left\{ \frac{0.6}{\sqrt{\text{sp. gr. gas}}} \right\}^{\frac{1}{2}}$$

For temperature of flowing gas when observed above 60 degrees F. deduct 1 per cent for each 5 degrees, and add a like amount for temperature of less than 60 degrees F.

In obtaining the approximate flow of a gas

TABLE 1

Discharge of gas of 0.6 specific gravity from one inch opening corresponding to water pressure in inches:

Pressure in inches	Cubic feet per hour	Pressure in inches	Cubic feet per hour	Pressure in inches	Cubic feet per hour	Pressure in inches	Cubic feet per hour
0.10	495	0.90	1,485	3.50	2,928	10.00	4,950
.20	714	1.00	1,555	4.00	3,130	11.00	5,215
.30	857	1.25	1,738	4.50	3,321	12.00	5,422
.40	980	1.50	1,915	5.00	3,500	13.85	5,800
.50	1,106	1.75	2,070	6.00	3,834	20.77	7,110
.60	1,213	2.00	2,214	7.00	4,140	27.70	8,200
.70	1,310	2.50	2,475	8.00	4,428		
.80	1,401	3.00	2,712	9.00	4,694		

TABLE 2

Discharge of gas of 0.6 specific gravity from one inch opening corresponding to pressure of mercury column and of gauge pressure:

Mercury pressure in inches	Pounds gauge pressure per square inch	Cubic feet per hour	Mercury pressure in inches	Pounds gauge pressure per square inch	Cubic feet per hour	Mercury pressure in inches	Pounds gauge pressure per square inch	Cubic feet per hour
.10	.05	1,835	5.59	2.75	13,375	.....	14.00	28,495
.20	.10	2,590	6.10	3.00	14,175	.....	15.00	29,295
.30	.15	3,170	6.61	3.25	14,755	.....	16.00	30,045
.40	.20	3,655	7.11	3.50	15,320	.....	17.00	30,755
.50	.25	4,095	7.62	3.75	15,850	.....	18.00	31,415
.60	.30	4,490	8.13	4.00	16,370	.....	20.00	32,730
.70	.35	4,850	8.64	4.25	16,875	.....	22.00	33,470
.80	.40	5,180	9.15	4.50	17,360	.....	25.00	35,620
.90	.45	5,495	9.65	4.75	17,845	.....	30.00	37,945
1.02	.50	5,790	10.16	5.00	18,330	.....	35.00	40,040
1.52	.75	7,095	12.20	6.00	19,835	.....	40.00	41,945
2.03	1.00	8,195	.....	7.00	21,555	.....	45.00	43,605
2.54	1.25	9,165	.....	8.00	22,600	.....	50.00	45,080
3.05	1.50	10,030	.....	9.00	23,735	.....	60.00	47,380
3.56	1.75	10,830	.....	10.00	24,815	.....	75.00	50,975
4.07	2.00	11,550	.....	11.00	25,915	.....	90.00	54,350
4.57	2.25	12,275	.....	12.00	26,775	.....	100.00	55,705
5.08	2.50	12,950	.....	13.00	27,695	.....	110.00	57,055

TABLE 3

Multipliers for pipe of other diameters than one inch:

Size of opening, diameter in inches	Multiplier	Size of opening, diameter in inches	Multiplier	Size of opening, diameter in inches	Multiplier	Size of opening, diameter in inches	Multiplier	Size of opening, diameter in inches	Multiplier
1/16	0.0038	1	1.00	4	16.00	6	36.00	8	64.00
1/8	.0156	1½	2.25	4¼	18.00	6¼	39.00	8¼	68.00
¼	.0625	2	4.00	5	25.00	6⅜	43.90	9	81.00
½	.2500	2½	6.25	5 3/16	26.90	7	49.00	10	100.00
¾	.5625	3	9.00	5⅝	31.60	7¼	52.50	12	144.00

well, these corrections are usually neglected.

Example 1—Suppose it is required to find the cubic feet output per day of a gas well or an orifice discharging from a 2-inch opening, the gauge in the Pitot tube showing a water pressure of 5.00 inches. In table 1 opposite this figure we find 3,500 cubic feet, which is the volume discharged by a 1-inch opening, but as 2-inch was the size on which the test was made this amount must be multiplied by the multiplier in the third table for 2-inch pipe, which is 4. Then we have 3,500 × 4 × 24 hours = 336,000 cubic feet, the daily flow.

Example 2—Suppose it is required to find the output per day of a gas well or orifice discharging from a 3-inch opening, the gauge showing a pressure of 30 pounds. Opposite this figure in table 2 we find 37,945; using the multiplier for 3-inch pipe in table 3, which is 9, we have 37,945 × 9 × 24 = 8,196,120 cubic feet, daily output of well.

CAPACITIES OF CHOKE NIPPLES

Values are thousands of cubic feet in 24 hours based on the following conditions: base pressure, 14.65 pounds absolute (four ounces); base and flowing temperature, 60 degrees F.; specific gravity, 0.60.

Upstream gage pressure pounds	Downstream gage pressure pounds	Diameter of choke in inches							
		0.125	0.188	0.250	0.313	0.375	0.500	0.625	0.750
1000	100	353	816	1497	2374	3457	6366	10152	14741
	500	353	815	1497	2373	3456	6365	10150	14738
	600	345	797	1463	2320	3379	6222	9922	14407
	700	322	744	1366	2166	3155	5810	9265	13454
	800	281	649	1191	1889	2750	5066	8078	11730
900	100	318	735	1350	2140	3116	5739	9151	13288
	450	318	735	1349	2139	3116	5738	9149	13286
	500	316	729	1339	2123	3902	5694	9079	13183
	600	299	690	1267	2009	2926	5389	8593	12477
	700	263	608	1116	1769	2576	4745	7566	10986
800	100	283	655	1202	1906	2775	5141	8151	11834
	400	283	655	1202	1905	2775	5110	8149	11832
	500	273	632	1160	1838	2677	4930	7862	11416
	600	244	564	1035	1640	2389	4399	7016	10187
	700	256	430	1084	1251	1822	4610	5350	7769
700	100	249	574	1054	1672	2435	4484	7150	10382
	350	249	574	1054	1672	2434	4482	7148	10379
	400	245	567	1041	1650	2403	4426	7058	10248
	500	223	516	947	1501	2186	4025	6419	9321
	600	173	399	732	1160	1690	3112	4962	7205
600	100	214	494	907	1438	2094	3856	6149	8928
	300	214	494	907	1437	2093	3855	6147	8926
	350	210	485	891	1412	2057	3788	6041	8772
	400	200	463	850	1347	1962	3614	5763	8368
	500	158	365	670	1061	1546	2847	4540	6592
500	100	179	414	759	1204	1753	3228	5148	7475
	250	179	414	759	1204	1753	3228	5148	7475
	300	175	403	740	1174	1709	3148	5020	7289
	350	163	376	690	1094	1594	2935	4680	6795
	400	142	327	601	953	1388	2556	4075	5917
450	100	162	373	685	1087	1583	2915	4648	6749
	200	162	373	685	1087	1583	2915	4648	6749
	250	160	370	679	1076	1568	2887	4604	6685
	300	151	349	641	1016	1480	2726	4347	6313
	350	133	307	564	893	1301	2396	3821	5548
400	100	144	333	612	970	1412	2601	4147	6022
	150	144	333	612	970	1412	2601	4147	6022
	200	144	333	611	969	1412	2600	4145	6019
	250	139	320	588	932	1357	2499	3985	5787
	300	123	285	523	830	1208	2225	3549	5153
350	100	127	293	538	853	1242	2287	3647	5295
	150	127	293	538	853	1242	2287	3647	5295
	200	125	288	529	839	1222	2251	3589	5211
	250	113	261	480	761	1108	2041	3255	4726
	300	87	202	370	587	855	1574	2510	3645
300	50	109	253	464	736	1071	1973	3147	4569
	100	109	253	464	736	1071	1973	3147	4569
	150	109	252	463	735	1070	1971	3143	4563
	200	102	235	432	685	998	1838	2930	4255
	250	80	185	389	538	784	1443	2302	3342

Choke nipples are used to control the delivery from the gas well and at the same time to retain a definite and practically constant working pressure at each well. The accompanying tabulation contains the daily capacities of a number of choke nipples in thousands of cubic feet at various inlet and outlet gage pressures in pounds per square inch. The figures in the table are based on the following conditions: base pressure, 14.65 pounds absolute (four ounces), base and following temperature 60 degrees F., and specific gravity 0.60. When these conditions vary, corrections must be made on the figures obtained from the table. The temperature and pressure corrections are made in the usual manner. The correction for difference in specific gravity is made by multiplying the table figures by the square root of (0.6 divided by the specific gravity of the gas measured).

CAPACITIES OF ORIFICES

Values are thousands of cubic feet in 24 hours, based on the following conditions: base presssure, 14.65 pounds absolute (four ounces); base and following temperature, 60 degrees F.; specific gravity, 0.60. Thickness of cylindrical portion of orifice not more than 25 per cent of the diameter of orifice.

Upstream gage pressure pounds	Downstream gage pressure pounds	Diameter of orifice in inches							
		0.125	0.188	0.250	0.313	0.375	0.500	0.625	0.750
1000	100	395	894	1580	2480	3560	6320	9870	14200
	500	351	795	1410	2200	3160	5620	8780	12600
	600	326	737	1300	2040	2930	5210	8140	11700
	700	292	660	1170	1830	2620	4670	7290	10500
	800	246	556	983	1540	2210	3930	6140	8850
900	100	356	805	1420	2230	3200	5700	8890	12800
	450	316	716	1270	1980	2850	5060	7910	11400
	500	304	689	1220	1910	2740	4870	7610	11000
	600	274	620	1100	1720	2470	4380	6840	9860
	700	232	524	927	1450	2090	3710	5790	8340
800	100	317	717	1270	1990	2850	5070	7910	11400
	400	282	637	1130	1770	2540	4510	7040	10100
	500	255	577	1020	1600	2300	4080	6370	9180
	600	217	491	868	1360	1950	3470	5420	7810
	700	158	358	633	992	1420	2530	3950	5690
700	100	277	628	1110	1740	2500	4440	6930	9990
	350	247	559	988	1550	2220	3950	6170	8890
	400	235	531	939	1470	2110	3750	5860	8450
	500	201	454	804	1260	1810	3210	5020	7320
	600	148	336	594	930	1340	2370	3710	5430
600	100	238	538	952	1490	2140	3810	5940	8570
	300	212	480	849	1330	1910	3390	5300	7640
	350	199	451	798	1250	1800	3190	4980	7180
	400	183	415	734	1190	1650	2940	4580	6610
	500	137	309	547	857	1230	2190	3410	4920
500	100	198	449	793	1240	1780	3170	4950	7140
	250	177	401	710	1110	1600	2840	4430	6390
	300	164	372	658	1030	1480	2630	4100	5920
	350	147	333	588	922	1320	2350	3670	5290
	400	124	280	495	776	1110	1980	3090	4460
450	100	178	403	713	1120	1600	2850	4450	6420
	200	165	374	661	1040	1490	2640	4130	5950
	250	154	348	615	964	1380	2460	3840	5540
	300	138	313	553	867	1240	2210	3450	4980
	350	117	264	468	733	1050	1870	2920	4210
400	100	158	357	632	991	1420	2530	3950	5690
	150	152	344	608	953	1370	2430	3800	5470
	200	143	322	570	894	1280	2280	3656	5130
	250	129	292	516	808	1160	2060	3220	4640
	300	110	248	438	687	986	1750	2740	3940
350	100	138	311	551	863	1240	2200	3440	4950
	150	130	295	522	817	1170	2090	3260	4690
	200	119	269	475	745	1070	1900	2970	4280
	250	102	230	407	637	915	1630	2540	3660
	300	75	170	300	470	675	1200	1870	2700
300	50	121	275	486	762	1090	1940	3040	4370
	100	117	264	467	732	1050	1870	2920	4210
	150	108	244	431	676	970	1720	2690	3880
	200	93	211	372	584	838	1490	2330	3350
	250	69	157	277	434	623	1110	1730	2490

Orifices are used to control the delivery from gas wells just as choke nipples. The same general conditions mentioned under choke nipples apply to orifices. The capacities given in the accompanying tabulation were prepared for orifices in which the thickness of the straight edge of the orifice is not greater than one-fourth of the diameter of the orifice.

BOILER OPERATION

BOILER CONDITIONS WHICH MAY BE DETECTED BY MEANS OF INSTRUMENT READINGS

Condition	Indications
1—Thickening fire	Increase of pressure under the grates, without rise in the flow meter reading. No appreciable change in CO_2.
2—Thinning fire	Decrease of pressures under the grates, without decrease in flow meter readings. No appreciable change in CO_2.
3—Holes in fire	Decrease in pressure under the grates, decrease of draft over the fire and decrease in the flow meter reading. Increase in the flue temperature. Decreased CO_2.
4—Accumulation of scale inside of Boiler Tubes or Slag or Soot on the outside of the tubes	Increase in flue temperature, indicated by the pyrometer, for the given boiler rating as shown by the flow meter. Accumulation of soot also increases the draft loss.
5—Holes in boiler baffles	Decreased draft through the boiler and increased flue gas temperature.
6—Holes in boiler settings	Decreased flue gas temperature and decreased CO_2 with usually increased draft—loss through the boiler depending on location of leak.
1—Pressure in the furnace	A positive pressure shown on the draft gauge over the fire.

DIMENSIONS OF CHIMNEYS

Height of Chimney Feet.	Lbs. of Coal per Hour per 1 Foot Area at Top of Chimney.	Height in Inches of Water Balanced by Draft Pressure.	H. P. of each Square Foot of Chimney at 7 lbs. Coal per H. P.	Area of Top of Chimney in Feet per H. P. for 1 or 2 Boilers.	Area of Top of Chimney in Feet per H. P. where several Boilers work together	Area of Flue in Feet per H. P.
30	78.24	.218	7.3	.146	.091	.182
40	90.35	.296	8.4	.126	.077	.155
50	101.01	.364	9.4	.113	.070	.140
60	110.65	.437	10.3	.103	.064	.129
70	119.52	.5	11.2	.095	.059	.119
80	127.77	.58	11.9	.089	.055	.111
90	135.52	.656	12.6	.084	.052	.105
100	142.85	.729	13.3	.08	.05	.100
125	159.71	.911	14.9	.071	.044	.089
150	174.96	1.09	16.3	.065	.04	.082
175	188.98	1.26	17.6	.060	.038	.075
200	202.03	1.45	18.8	.056	.035	.070
225	214.28	1.64	20.0	.053	.033	.066
250	225.87	1.82	21.0	.05	.031	.063
275	236.90	1.99	22.0	.048	.03	.06
300	247.43	2.18	23.0	.046	.028	.057

DATA ON BOILER WORKS CAPACITY

Water Gas Plants

Boiler Capacity Required Apparatus	Capacity per M. C. F. per 24 hours
Generator	.100 hp.
Blowers	.080 " (1)
Pumps	.013 "
Exhausters	.014 "
Condensation and Leakage	.010 "
	.137 "
Heating Buildings	.015 " (2)
Heating Holders	.022 " (2)
Machine Shop	.017 " (2)
	.191 "

(1) Not included in totals, as blowers are not operated when generators are on the run.
(2) For locations similar to New York.

Coal Gas Plants

Boiler Capacity Required Apparatus	Capacity per M. C. F. per 24 hours
Exhausters	.017 hp.
Pumps	.015 "
Rotary Scrubber	.010 "
Coal Crushing and Conveying Apparatus	.035 "
Coke Handling Apparatus, Elevators and Screens	.035 "
Charging and Discharging Machinery	.020 "
Ammonia Concentrator	.035 "
Condensation and Leakage	.010 "
	.177 "
Heating Buildings	.015 " (2)
Heating Holders	.022 " (2)
Machine Shop	.017 " (2)
	.233 "

PURIFICATION

SPECIFIC GRAVITY OF MILK OF LIME AT 15° C. = 59° F.

Degrees Baume	1 liter of Lime weighs, Grammes	Grammes of Lime (CaO) in 1 liter	Ounces of Lime (CaO) in 1 gal.	% Lime by Wt.	Degrees Baume	1 liter of Lime weighs, Grammes	Grammes of Lime (CaO) in 1 liter	Ounces of Lime (CaO) in 1 gal.	% Lime by Wt.
4	1029	36	4.8	3.54	14	1108	137	18.3	12.35
6	1045	56	7.5	5.36	15	1116	148	19.8	13.26
7	1052	65	8.7	6.18	16	1125	159	21.2	14.13
8	1060	75	10.0	7.08	17	1134	170	22.7	15.00
9	1067	84	11.2	7.87	18	1142	181	24.2	15.00
10	1075	94	12.5	8.74	19	1152	193	25.8	16.75
11	1083	104	13.9	9.60	20	1162	206	27.5	17.72
12	1091	115	15.4	10.54	25	1210	268	35.8	22.15
13	1100	126	16.8	11.45	30	1263	339	45.3	26.84

If 1 liter contains 1 gramme, 1 gallon contains 1,335 ounces.

AVERAGE OPERATING RESULTS OBTAINED WITH DIFFERENT TYPES OF CONDENSERS

	Air Temp., Deg. F.	Gas Temperature Inlet Deg. F.	Gas Temperature Outlet Deg. F.	Cooling Water Temperature Inlet Deg. F.	Cooling Water Temperature Outlet Deg. F.	Gals. Water per 1000 Cu. Ft. Gas	Cooling Surface Provided in Sq. Ft. Per 1000 Cu. Ft. Cooled Per Hour	Cooling Surface Provided in Sq. Ft. Per 1000 Cu. Ft. Cooled Per Day
1. Water cooled.....	54	158	77	52	127	26.6	75.6	3.15
2. Vertical water tube condenser	..	128	70.6	66	84.4	40	53.7	2.23
3. Horizontal water tube condenser	47.5	140	62.5	52	112	18.9	54.2	2.26
Horizontal water tube condenser	47.5	157	59	47	131	22.8	57.8	2.41
4. Vertical water tube condenser	37	155	82	42	144	12.8	69.6	2.9
Vertical water tube condenser	80	170	91	75	136	29.0	69.6	2.9
5. Horizontal water tube condenser	80A	170	80A	75A	150	35	83.0	3.46
6. Vertical gas tube water cooled condenser	62	170	72	65	126	52.7.	36.9	1.53
7. Vertical gas tube water cooled condenser	89	182	76	71	120	75.5	36.9	1.53
8. Evaporative condenser	50	138	66B	55	75	2.0C	43.5	1.81
Horizontal gas tubes	72	148	68B	61	97	18.2	43.5	1.81
Horizontal gas tubes	101	142	73B	74	85	27.5	43.5	1.81

NOTES—
A. These temperatures are estimated.
B. Gas actually cooled to this temperature, with 33.0 sq. ft. of cooling area per 1000 cu. ft.
C. No water used at night time. Gas regularly cooled to between 60 and 70 deg. F.

COST OF OXIDE PURIFICATION

The cost of purification is made up as folfolsw, viz.:

1. The purchase price of the ore.
2. The cost of shavings and mixing.
3. The cost of filling and emptying boxes.
4. The loss of gas on emptying boxes.
5. Overhead, supervision, etc.

Take two materials, A and B. A costs $15 a ton and B $10 a ton, moisture free material. Each is mixed 25 lbs. to the bushel and 4,000 bushels are put in a box. Gas containing 2 per cent of air is passed through at the rate of 200,000 cubic feet per hour. Each box is left on until 75 per cent of the entering H_2S passes into the outlet gas. When this occurs, A has passed 400 million cubic feet of gas, and B 300 million cubic feet. Each is then emptied, revivified, and the process repeated. This time A passes 360 million cubic feet, and B 250 million cubic feet. The boxes are again emptied, the oxide revivified and put back for the third fouling. This time A passes 200 million cubic feet, and B 100 million cubic feet. The oxides are now completely fouled and must be thrown away. What is the purification cost per 1,000,000 cubic feet for each oxide?

	"A"	"B"
4,000 bu. @ 25 lbs. per bu. = 100,000 lbs. = 50 tons.....	$750.00	$500.00
Filling and empting each box 3 times..	500.00	500.00
Shavings for each box and labor in mixing	200.00	200.00
Total cost per box...	$1,450.00	$1,200.00
	cu. ft.	cu. ft.
Total gas purified...	960,000,000	650,000,000

Cost per million cu. ft. $1.51 $1.85

Therefore, while the original cost of material A was 50 per cent greater than that of B, the cost of purification by B was 22.5 per cent greater than with A.

OUNCE LIQUOR EQUIVALENTS

The strength of ammonia liquor is often expressed in the terms of "ounce" concentration. When a liquor is called "five ounce strength" it is meant that alkalinity of the ammonia that is contained in one gallon of the liquor will be neutralized by five ounces of pure sulphuric acid.

1 ounce liquor will contain 0.347 ounces
equals 0.0217 lb. NH_3 per gal.
5 ounce liquor will contain 1.735 ounces
equals 0.1085 lb. NH_3 per gal.
10 ounce liquor will contain 3.469 ounces
equals 0.2169 lb. NH_3 per gal.
20 ounce liquor will contain 6.939 ounces
equals 0.4338 lb. NH_3 per gal.
40 ounce liquor will contain 13.878 ounces
equals 0.8676 lb. NH_3 per gal.
60 ounce liquor will contain 20.816 ounces
equals 1.3014 lb. NH_3 per gal.

Specific gravity is not an accurate measure of the strength of the ammonia liquor for the reason that the latter often contains impurities like carbon dioxide, sulphuretted hydrogen, etc., which act to increase the specific gravity of the liquor. For weak liquors it is commonly held that—

1 degree Twaddle equals 2 ounces strength
2 degrees Twaddle equals 4 ounces strength
4 degrees Twaddle equals 8 ounces strength

NOTES ON AMMONIA AND AMMONIUM SULPHATE

In ordinary carbonization of coal, the yield of ammonium sulphate per pound of coal is from 15 to 35 pounds, which is equivalent to 18 to 42 gallons of the ten-ounce ammonia liquor.

In making neutral ammonium sulphate, one ton of ammonia (25 per cent fixed ammonia) requires 0.411 ton of pure quicklime and 2.88 tons of pure sulphuric acid.

One ton of ammonium sulphate (25 per cent) requires 0.103 ton of quicklime and 0.72 ton of sulphuric acid.

The acid used is usually 142 degrees Tw. (78 per cent concentration) and the quicklime is 90 per cent pure. The figures for one ton of ammonium sulphate then become 0.115 ton of quicklime and 0.92 ton of sulphuric acid.

HEAT REMOVED IN COOLING GAS

The following table gives the amount of heat that must be removed from 1000 cu. ft. of gas (measured at 60 degrees F.) to cool it from the given temperature to 60 degrees F. The gas is saturated. It also gives the amount of cooling water required in the condensers:

Temperature in deg. F.	B.t.u. above 60 deg. F.	COOLING WATER Gallons per M.	COOLING WATER If temperature rise deg. F.
60	0	0	0
70	500	6	10
80	1200	7.2	20
90	2000	8	30
100	3100	9.3	40
110	4500	10.8	50
120	6600	12	60
130	9300	16	70
140	13000	19.5	80
150	18600	25	90
160	26000	31.2	100
170	37000	40	110
180	56000	56	120
190	90000	83	130
200	220000	190	140

Thus, if the temperature of the gas is 160 degrees F. it will contain 26,000 B.T.U. above 60 degrees F. per 1,000 cubic feet. If the quantity of gas to be cooled is 100,000 cubic feet, then the amount of cooling water required is $31.2 \times 100 = 3{,}120$ gallons, if the temperature rise is 100 degrees F.

WASHING AND SCRUBBING

The work done in washing and scrubbingties in 100 cubic feet of gas at the outlet of is indicated in the following table, which givescondensers and outlet of scrubbers, respec-the number of grains of the various impuri-tively:

Impurity	Outlet of Condenser	Outlet of Scrubbers
Ammonia	200- 300	Nil- 1.5
Sulphuretted Hydrogen	500- 900	500- 800
Carbon Dioxide	900-1400	700-1150
Sulphur Compounds	35- 45	30- 45
Hydrocyanic Acid	60- 80	50- 70
Naphthalene	20- 25	14- 20

SPECIFIC GRAVITY OF AQUA AMMONIA

(Solution of Ammonia (NH_3) In Distilled Water)

Specific Gravity at 15°C. (Water at 15°C. = 1)	% N H_3 by weight	Grams of NH_3 in 1 liter	Specific Gravity at 15°C. (Water at 15°C. = 1)	% N H_3 by weight	Grams of NH_3 in 1 liter
1.000	.00	.0	.940	15.63	146.9
.998	.45	4.5	.938	16.22	152.1
.996	.91	9.1	.936	16.82	157.4
.994	1.37	13.6	.934	17.42	162.7
.992	1.84	18.2	.932	18.03	168.1
.990	2.31	22.9	.930	18.64	173.4
.988	2.80	27.7	.928	19.25	178.6
.986	3.30	32.5	.926	19.87	184.2
.984	3.80	37.4	.924	20.49	189.3
.982	4.30	42.2	.922	21.12	194.7
.980	4.80	47.0	.920	21.75	200.1
.978	5.30	51.8	.918	22.39	205.6
.976	5.80	56.6	.916	23.03	210.9
.974	6.30	61.4	.914	23.68	216.3
.972	6.80	66.1	.912	24.33	221.9
.970	7.31	70.9	.910	24.99	227.4
.968	7.82	75.7	.908	25.65	232.9
.966	8.33	80.5	.906	26.31	238.3
.964	8.84	85.2	.904	26.98	243.9
.962	9.35	89.9	.902	27.65	249.4
.960	9.91	95.1	.900	28.33	255.0
.958	10.47	100.3	.898	29.01	260.5
.956	11.03	105.4	.896	29.69	266.0
.954	11.60	110.7	.894	30.37	271.5
.952	12.17	115.9	.892	31.05	277.0
.950	12.74	121.0	.890	31.75	282.6
.948	13.31	126.2	.888	32.50	288.6
.946	13.88	131.3	.886	32.25	294.6
.944	14.46	136.5	.884	34.10	301.4
.942	15.05	141.7	.882	34.95	308.3

Standard aqua ammonia has a specific gravity of about .898 = 26.4° Baume.

SPECIFIC GRAVITY AND EQUIVALENT GALLONS PER TON OF TAR

Sp. Gr. Water = 1	Gallons Per Ton	Sp. Gr. Water = 1	Gallons Per Ton
1.000	224.0	1.155	193.9
1.005	222.9	1.160	193.1
1.010	221.8	1.165	192.3
1.015	220.7	1.170	191.5
1.020	219.6	1.175	190.7
1.025	218.5	1.180	189.8
1.030	217.5	1.185	189.0
1.035	216.5	1.190	188.2
1.040	215.4	1.195	187.5
1.045	214.4	1.200	186.7
1.050	213.3	1.205	185.9
1.055	212.3	1.210	185.1
1.060	211.2	1.215	184.4
1.065	210.3	1.220	183.6
1.070	209.3	1.225	182.9
1.075	208.4	1.230	182.1
1.080	207.4	1.235	181.4
1.085	206.5	1.240	180.6
1.090	205.5	1.245	179.9
1.095	204.6	1.250	179.2
1.100	203.6	1.255	178.5
1.105	202.7	1.260	177.8
1.110	201.8	1.265	177.1
1.115	200.9	1.270	176.4
1.120	200.0	1.275	175.7
1.125	199.1	1.280	175.0
1.130	198.2	1.285	174.3
1.135	197.4	1.290	173.6
1.140	196.5	1.295	173.0
1.145	195.7	1.300	172.3
1.150	194.8		

PROPERTIES OF DRY AIR AT ELEVATED TEMPERATURES

Temp. Deg. F.	Weight per cu. ft. lbs.	Weight approx. ratio to wt. at 70 deg.	Volume per lb. cu. ft.		Specific Heat	Temp. Deg. F.	Weight per cu. ft. lbs.	Weight approx. ratio to wt. at 70 deg.	Volume per lb. cu. ft.		Specific Heat
32	080728	1.08	12.387		.2377	1100	.025446	.340	39.299		.2581
70	074935	1.00	13.345		.2383	1200	.023913	.320	41.818		.2600
100	070919	.946	14.429		.2388	1300	.022554	.301	44.338		.2619
150	065102	.870	15.361		.2400	1400	.021341	.285	46.858		.2637
200	060167	.805	16.621		.2408	1500	.020252	.274	49.378		.2655
250	057320	.765	17.473		.2418	1600	.019269	.258	51.898		.2673
300	052246	.699	19.140		.2427	1700	.018376	.245	54.417		.2692
350	049019	.655	20.400		.2437	1800	.017563	.234	59.637		.2711
400	046168	.618	21.660		.2447	1900	.016819	.225	59.457		.2730
450	043630	.570	22.920		.2457	2000	.016135	.216	61.977		.2750
500	041357	.551	24.180		.2467	2100	.015505	.207	64.497		.2769
550	039581	.529	25.265		.2476	2200	.014922	.200	67.016		.2787
600	037462	.501	26.693		.2485	2300	.014381	.192	69.536		.2806
650	034224	.457	29.219		.2505	2400	.013878	.185	72.056		.2824
750	032809	.438	30.479		.2513	2500	.013409	.179	74.576		.2843
800	031507	.421	31.739		.2522	2600	.012971	.173	77.095		.2862
850	030304	.405	32.999		.2532	2700	.012560	.168	79.615		.2881
900	029189	.390	34.259		.2542	2800	.012175	.162	82.135		.2900
950	028154	.376	35.519		.2551	2900	.011813	.158	84.655		.2920
1000	027189	.363	36.779		.2561	3000	.011471	.153	87.175		.2940

Table Showing Capacities of Pumps in U. S. Gallons

Diam. Pumps in Inches	Piston Speed in Feet per Minute											Diam. Pumps in Inches
	40	50	60	70	80	90	100	125	150	175	200	
1½	3.67	4.58	5.51	6.42	7.34	8.25	9.17	.....	.....	.....	.....	1½
1¾	5.00	6.25	7.49	8.75	10.00	11.25	12.50	.....	.....	.....	.....	1¾
2	6.53	8.15	9.79	11.41	13.06	14.67	16.32	.....	.....	.....	.....	2
2¼	8.26	10.32	12.39	14.45	16.52	18.58	20.65	.....	.....	.....	.....	2¼
2½	10.20	12.75	15.30	17.85	20.40	22.95	25.50	.....	.....	.....	.....	2½
2¾	12.34	15.42	18.51	21.59	24.68	27.67	30.85	.....	.....	.....	.....	2¾
3	14.69	18.36	22.03	25.70	29.38	33.04	36.72	.....	.....	.....	.....	3
3¼	17.24	21.54	25.86	30.16	34.48	38.78	43.09	.....	.....	.....	.....	3¼
3½	19.99	24.99	29.99	34.98	39.98	44.98	49.98	62.47	.....	.....	.....	3½
3¾	22.95	28.68	34.42	40.15	45.90	51.63	57.37	71.72	.....	.....	.....	3¾
4	26.11	32.64	39.17	45.19	52.22	58.75	65.28	81.60	97.92	.....	.....	4
4¼	29.48	36.84	44.22	51.58	58.96	66.32	73.69	92.12	110.54	.....	.....	4¼
4½	33.05	41.31	49.57	57.83	66.10	75.35	82.62	103.27	123.93	144.59	.....	4½
4¾	36.82	46.02	55.23	64.43	73.64	82.84	92.05	115.07	138.08	161.10	.....	4¾
5	40.80	51.00	61.20	71.00	81.60	91.80	102.00	127.50	153.00	178.50	204.00	5
5¼	44.78	56 22	67.47	78.71	89.56	101.20	112.45	140.51	168.68	196.67	224.91	5¼
5½	49.37	61.70	74.05	86.39	98.74	111.07	123.42	154.27	185.13	215.98	246.84	5½
5¾	53.96	67.44	80.94	94.42	107.92	121.40	134.89	168.62	202.34	236.07	269.79	5¾
6	58.75	73.44	88.13	102.71	117.50	132.19	146.88	183.60	220.32	257.04	293.76	6
6½	68.95	86.19	103.43	120.66	137.90	155.14	172.38	215.47	258.57	301.66	344.76	6½
7	79.97	99.96	119.95	139.94	159.94	179.92	199.92	249.90	299.88	349.86	399.84	7
7½	91.80	114.75	137.70	160.65	183.60	206.55	229.50	286.88	344.25	401.62	459.00	7½
8	104.45	130.56	156.67	182.78	208.90	235.00	261.12	326.40	391.68	456.96	522.24	8
8½	117.91	147.39	176.87	206.34	235.82	265.30	294.78	368.47	442.17	515.86	589.56	8½
9	132.19	165.24	198.29	231.33	264.38	297.43	330.48	413.10	495.72	578.34	660.96	9
9½	147.29	184.11	220.93	257.75	294.58	331.39	368.22	460.27	552.33	644.38	736.44	9½
10	163.20	204.00	244.80	285.60	326.40	367.20	408.00	510.00	612.00	714.00	816.00	10
10½	179.93	224.91	269.89	314.87	329.86	404.83	449.82	562.27	674.73	787.18	899.64	10½
11	197.47	246.84	296.21	345.57	394.94	444.31	493.68	617.10	740.52	863.94	987.36	11
12	235.00	293.75	352.50	411.25	470.00	528.75	587.50	734.40	881.30	1028.20	1175.00	12
13	275.80	344.75	413.70	482.65	551.60	620.55	689.50	861.90	1034.30	1206.70	1379.00	13
14	319.90	399.85	479.80	559.79	639.70	719.73	799.70	999.60	1199.50	1399.40	1599.40	14
15	367.20	459.00	550.80	642.60	734.40	826.20	918.00	1147.50	1377.00	1606.50	1836.00	15
16	417.80	522.25	626.70	731.15	835.60	940.05	1044.50	1305.60	1566.70	1827.80	2089.00	16
18	528.80	660.95	793.20	925.33	1057.50	1189.71	1321.90	1652.40	1982.90	2313.40	2643.80	18
20	652.80	816.00	979.20	1142.42	1305.60	1468.80	1632.00	2040.00	2448.00	2856.00	3264.00	20
22	789.90	987.35	1184.80	1382.29	1579.80	1777.23	1974.70	2468.40	2962.10	3455.80	3949.40	22
24	940.00	1175.05	1410.00	1645.07	1880.10	2115.09	2350.10	2937.60	3525.10	4112.60	4700.10	24
26	1103.20	1379.05	1654.80	1930.67	2206.50	2482.29	2758.10	3447.60	4137.10	4826.60	5516.10	26
28	1279.50	1599.35	1919.20	2239.09	2559.00	2878.83	3198.70	3998.40	4798.10	5597.70	6397.40	28
30	1468.80	1836.00	2203.20	2570.40	2937.60	3304.80	3672.00	4590.00	5508.00	6426.00	7344.00	30
32	1671.20	2088.95	2506.70	2924.53	3342.30	3760.11	4177.90	5222.40	6266.90	7311.40	8355.80	32
36	2115.10	2643.85	3172.60	3701.39	4230.14	4758.93	5287.70	6609.60	7931.50	9253.40	10575.30	36
40	2611.20	3264.00	3916.80	4569.60	5222.40	6775.20	6528.00	8160.00	9792.00	11424.00	13056.00	40
48	3760.10	4700.15	5640.20	6580.21	7520.20	8460.27	9400.30	11750.40	14100.40	16450.50	18800.60	48

CAPACITY OF HORIZONTAL CYLINDRICAL TANKS

For calculating the capacity of a horizontal cylindrical tank the following formula and table will be found convenient:

Let D equal diameter of tank in feet.

Let L equal length of tank in feet.

Let H equal height in feet of the liquid in the tank.

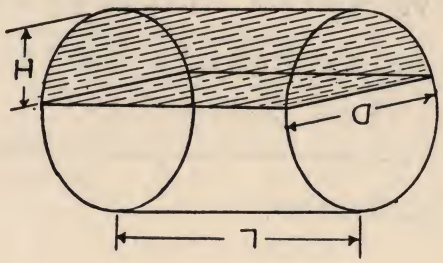
$$\frac{H}{D}$$

First calculate — and find the corresponding value of O from the table given herewith. (D is used in inches here.)

Then the number of cubic feet in the tank $= L \times O \times D^2$.

American Gas Catalog and Handbook

Gallons of liquid in tank = L x O x D^2 x 7.478.



Example: A tank 4 feet in diameter and 11 feet long is filled with liquid to a depth of 16 inches.

Then $\frac{H}{D} = \frac{16}{48} = .333$, and from the table the corresponding value of O = .22886.

Hence the number of gallons = 11 x .22886 x 4 x 4 x 7.478 = 301.

$\frac{H}{D}$	Value of O.									
	·000	·001	·002	·003	·004	·005	·006	·007	·008	·009
·00	·00000	·00004	·00012	·00022	·00034	·00047	·00062	·00078	·00095	·00113
·01	·00133	·00153	·00175	·00197	·00220	·00244	·00268	·00294	·00320	·00347
·02	·00375	·00403	·00432	·00462	·00492	·00523	·00555	·00587	·00619	·00653
·03	·00687	·00721	·00756	·00791	·00827	·00864	·00901	·00938	·00976	·01015
·04	·01054	·01093	·01133	·01173	·01214	·01255	·01297	·01339	·01382	·01425
·05	·01468	·01512	·01556	·01601	·01646	·01691	·01737	·01783	·01830	·01877
·06	·01924	·01972	·02020	·02068	·02117	·02166	·02215	·02265	·02315	·02366
·07	·02417	·02468	·02520	·02571	·02624	·02676	·02729	·02782	·02836	·02889
·08	·02943	·02998	·03053	·03108	·03163	·03219	·03275	·03331	·03387	·03444
·09	·03501	·03559	·03616	·03674	·03732	·03791	·03850	·03909	·03968	·04028
·10	·04087	·04148	·04208	·04269	·04330	·04391	·04452	·04514	·04576	·04638
·11	·04701	·04763	·04826	·04889	·04953	·05016	·05080	·05145	·05209	·05274
·12	·05338	·05404	·05469	·05535	·05600	·05666	·05733	·05799	·05866	·05933
·13	·06000	·06067	·06135	·06203	·06271	·06339	·06407	·06476	·06545	·06614
·14	·06683	·06753	·06822	·06892	·06963	·07033	·07103	·07174	·07245	·07316
·15	·07387	·07459	·07531	·07603	·07675	·07747	·07819	·07892	·07965	·08038
·16	·08111	·08185	·08258	·08332	·08406	·08480	·08554	·08629	·08704	·08778
·17	·08854	·08929	·09004	·09080	·09155	·09231	·09307	·09384	·09460	·09537
·18	·09613	·09690	·09767	·09845	·09922	·10000	·10077	·10155	·10233	·10312
·19	·10390	·10469	·10547	·10626	·10705	·10784	·10864	·10943	·11023	·11102
·20	·11182	·11262	·11343	·11423	·11504	·11584	·11665	·11746	·11827	·11908
·21	·11990	·12071	·12153	·12235	·12317	·12399	·12481	·12563	·12646	·12729
·22	·12811	·12894	·12977	·13060	·13144	·13227	·13311	·13395	·13478	·13562
·23	·13646	·13731	·13815	·13900	·13984	·14069	·14154	·14239	·14324	·14409
·24	·14494	·14580	·14665	·14751	·14837	·14923	·15009	·15095	·15182	·15268
·25	·15355	·15441	·15528	·15615	·15702	·15789	·15876	·15964	·16051	·16139
·26	·16226	·16314	·16402	·16490	·16578	·16666	·16755	·16843	·16932	·17020
·27	·17109	·17198	·17287	·17376	·17465	·17554	·17644	·17733	·17823	·17912
·28	·18002	·18092	·18182	·18272	·18362	·18452	·18542	·18633	·18723	·18814
·29	·18905	·18996	·19086	·19177	·19268	·19360	·19451	·19542	·19634	·19725
·30	·19817	·19908	·20000	·20092	·20184	·20276	·20368	·20460	·20553	·20645
·31	·20738	·20830	·20923	·21015	·21108	·21201	·21294	·21387	·21480	·21573
·32	·21667	·21760	·21853	·21947	·22040	·22134	·22228	·22322	·22415	·22509
·33	·22603	·22697	·22792	·22886	·22980	·23074	·23169	·23263	·23358	·23453
·34	·23547	·23642	·23737	·23832	·23927	·24022	·24117	·24212	·24307	·24403
·35	·24498	·24593	·24689	·24784	·24880	·24976	25071	·25167	·25263	·25359
·36	·25455	·25551	·25647	·25743	·25839	·25936	·26032	·26128	·26225	·26321
·37	·26418	·26514	·26611	·26708	·26805	·26901	·26998	·27095	·27192	·27289
·38	·27386	·27483	·27580	·27677	·27775	·27872	·27969	·28070	·28164	·28262
·39	·28359	·28457	·28554	·28652	·28750	·28847	·28945	·29043	·29141	·29239
·40	·29337	·29435	·29533	·29631	·29729	·29827	·29926	·30024	·30122	·30220
·41	·30319	·30417	·30516	·30614	·30712	·30811	·30910	·31008	·31107	·31205
·42	·31304	·31403	·31502	·31600	·31699	·31798	·31897	·31996	·32095	·32194
·43	·32293	·32392	·32491	·32590	·32689	·32788	·32887	·32987	·33086	·33185
·44	·33284	·33384	·33483	·33582	·33682	·33781	·33880	·33980	·34079	·34179
·45	·34278	·34378	·34477	·34577	·34676	·34776	·34876	·34975	·35075	·35174
·46	·35274	·35374	·35474	·35573	·35673	·35773	·35872	·35972	·36072	·36172
·47	·36272	·36371	·36471	·36571	·36671	·36771	·36871	·36971	·37071	·37170
·48	·37270	·37370	·37470	·37570	·37670	·37770	·37870	·37970	·38070	·38170
·49	·38270	·38370	·38470	·38570	·38670	·38770	·38870	·38970	·39070	·39170
·50	·39270									

For values of $\frac{H}{D}$ above ·500, see note below.

NOTE.—If $\frac{H}{D}$ comes over ·500, subtract it from unity, obtain the corresponding value of O from the table and subtract this value from ·78540. The resulting figure is the true value for O to be employed in the calculations.

THE BARTLETT HAYWARD COMPANY

Main Office and Works **Pershing Square Building**
Baltimore, Md. **New York City**

DESIGNERS AND BUILDERS
OF

COMPLETE COAL GAS PLANTS
CARBURETTED WATER GAS PLANTS
BLUE WATER GAS PLANTS
OIL GAS PLANTS
BY-PRODUCT PLANTS
DE BROUWER CHARGING AND DISCHARGING MACHINES
SALT WATER AND FRESH WATER CONDENSERS
TAR EXTRACTORS
PURIFIERS
B. H. CO. VERTICAL CENTRIFUGAL SCRUBBERS
(Feld Type)
B. H. CO. THICKENER
(Genter Type)
STEEL TANKS
VERTICAL WASTE HEAT BOILERS
B. H. CO. WESTLING VALVE
(Patent Applied For)
FAST'S FLEXIBLE COUPLINGS

GAS HOLDERS

THE BARTLETT HAYWARD COMPANY'S MAIN PLANT

DE BROUWER CHARGING AND DISCHARGING MACHINES

Charging and Discharging Machines to suit any condition and capacity required.

These chargers and dischargers can be adapted to any size of plant, and they are so constructed and operated that the retort can be practically filled to the top if desired. In the adoption of these machines, the retort house is usually supplied with an overhead coal bunker, the bottom of which is provided with valves for filling the bin of the charger. The laying of a charge of proper cross-section is dependent upon the rate of deceleration of the speed of the charger belt as well as upon the flow of coal upon the belt, and these two requirements are controlled automatically. The discharger is supplied with an automatic limit switch for stopping the ram at the end of the forward stroke, returning the ram to the "home" position and holding it there, thus making it automatic in its action. The machines are very rugged in construction and maintenance charges are low. Besides the individual chargers and dischargers we also build a combination machine. All chargers are supplied with accurate weighing devices, thus giving a complete daily record of all coal charged.

CONDENSERS

Steel Condensers for fresh water.

Cast Iron Condensers for salt water.

Circular, Rectangular or Oval Condensers, with one or multi-flow gas passage, built to any capacity.

These Condensers are built for all kinds of service and have been installed in coke oven, coal gas, carburetted water gas and blue water gas plants.

TAR EXTRACTORS

P. & A. Tar Extractors
Shavings Scrubbers
Feld Type Scrubbers

GAS PURIFICATION

Purifier Boxes of any desired capacity built of steel or cast iron with the most efficient means for removing oxide and refilling boxes.

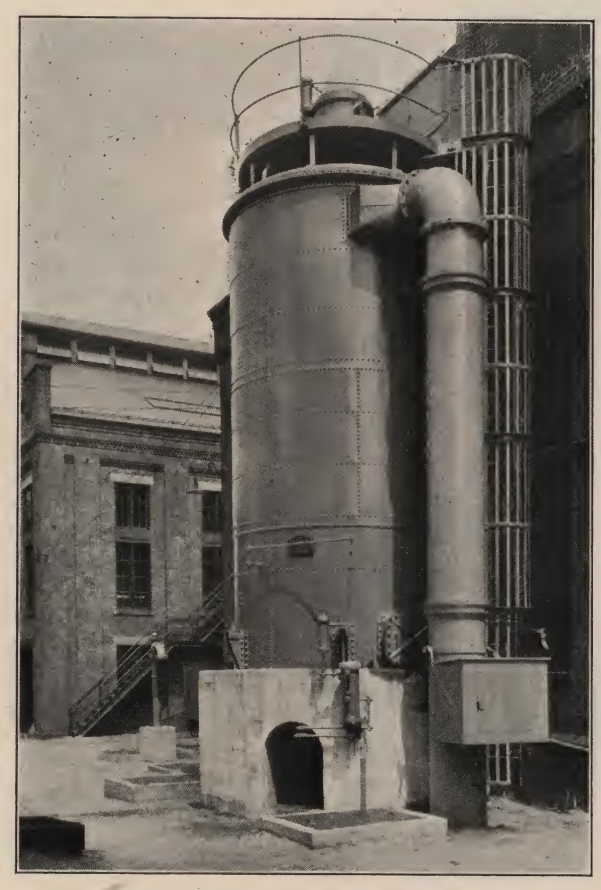
VERTICAL CENTRIFUGAL SCRUBBERS (Feld Type)

These Scrubbers are used for the removal of Tar, Napthalene, Cyanogen, Ammonia, Light Oils, and other products, also for removing dust from producer gas, from blast furnace gas, and many other chemical purposes where intimate contact between gas and the scrubbing liquid is required. The gas and washing liquid pass through the scrubber in counter-current, and the many re-sprayings in each successive chamber insures the highest extraction efficiency as well as maximum saturation, with a minimum supply of scrubbing liquid. The scrubber is built without internal bearings and consequently is readily accessible for lubrication.

CARBURETTED WATER GAS

Complete Carburetted Water Gas Plants, including foundations and buildings.

Three Shell Machines of Modern Design and large capacity.



Vertical Centrifugal Scrubber

Condensers, Tar Extractors, Scrubbers, Purifiers of cast iron, steel or concrete.

Waste Heat Water Tube Boilers.

Complete Fuel Handling Equipment.

High Pressure Blower Units and Blast Piping.

Gate Valves and Special Fittings.

Critchlow Operating Valves.

We build complete carburetted and blue water gas plants of all sizes, containing the latest labor saving equipment.

The gas machines are constructed with extra large connections and high pressure blowing equipment to obtain maximum outputs.

BY-PRODUCT PLANTS

Complete Plants for the manufacture of Concentrated Ammonia, Aqua Ammonia and Ammonium Sulphate for the recovery of Tar, Cyanogen, Benzol and other products.

WATER TANK GAS HOLDERS AND STEEL TANKS

Water Tank Gas Holders of all sizes, ranging from 100,000 to 15,000,000 cubic feet capacity.

Steel Tanks of all descriptions.

WATERLESS HOLDER

The Waterless Holder was introduced by us in this country in 1924 and since that time we have built a total of 37 holders of this type totaling 238,750,000 cubic feet storage, in sizes up to 20,000,000 cubic feet capacity and have under construction a total of 35,000,000 cubic feet capacity. Fifteen of these holders were repeat orders. Some of the advantages of the Waterless Holder over the Water Tank Holder are:

Simpler and cheaper foundations due to elimination of the heavy tank, as well as the water required to fill the tank.

No cupping and uncupping of holder sections.

Simpler operation in cold weather due to the use of tar as the sealing medium instead of water.

Steam saving in winter due to elimination of tank and cup heating.

Lower maintenance cost for painting the holder shell since there is no submergence of any metal in water.

Improved appearance as a structure.

Uniform gas pressure for the entire capacity of the holder.

Larger capacity holder can be built on a given area.

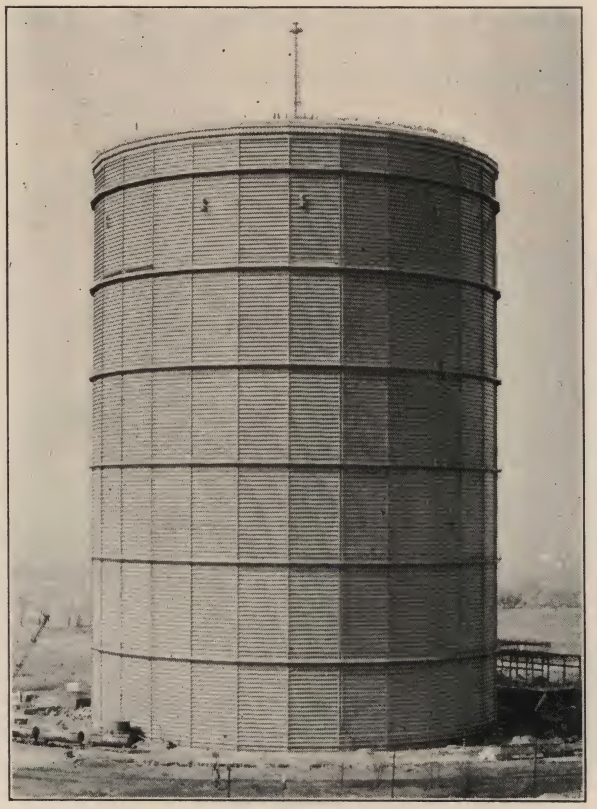
No shoveling of snow from crown after a heavy snowfall, since the roof always protects the piston from snow.

KENNEDY AUTOMATIC CONTROL

This control is for the automatic operation of carburetted water gas, blue gas and oil gas sets.

Built into this apparatus are certain exclusive features which insure the flexibility of control and ease of adjustment required for all the conditions of operation of the gas making apparatus. These features allow the technical skill of the superintendent full play in securing maximum efficiency with a substantial elimination of labor.

Predominant are its safety features which insure safety by the simple method of preventing the conditions which cause accidents. Its automatic interlock is unique in application and basically correct, because no valve on the set can be operated unless the preceding valve in the sequence has successfully and completely operated.



WATERLESS GAS HOLDER

Co-operating with this feature is the Automatic Shut-Down which brings the set to a safe shut down condition whenever a valve fails to operate successfully.

B. H. CO. THICKENER (Genter Type)

The B. H. Co. Genter Type Thickener is a filter-thickener wherein the solids are primarily removed from suspension by filtration, i. e., the clear liquid is passed through a filter medium which retains the suspended solids on its exterior and these solids are then removed in cake form, periodically and automatically, into the mixture being thickened and the thickened sludge is removed by gravity through a mud line at the bottom of the thickener tank. The outstanding advantages of this thickener are higher concentration with clear filtrate, compact and accessible design, small amount of liquid in process, flexible operation, reserve capacity, high heat conservation, low installation cost.

B. H. CO. WESTLING VALVE (Patent Applied For)

The B. H. Co. Westling Valve is an all metal positive shut-off valve of the goggle plate type for use primarily in producer and blast furnace gas mains where the gas carries large quantities of dust and may be at temperatures up to 1000° F.

KENNEDY AUTOMATIC CONTROL

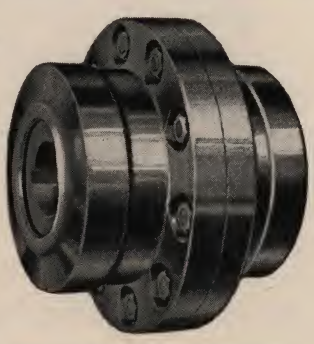
The valve consists of a rolled steel goggle plate, one half of which is solid, the other having an opening the size of the gas main. This plate is pivoted between two cast steel girder type frames of special design having machined faces.

The joints between the faces of the frames and the goggle plate are made gas tight by clamping the frames on the plate at high pressure by means of three simultaneously operated differential screws. The valve is complete as shipped, ready to be bolted in the main and requires no supports, foundations, piping, wiring or any other auxiliary devices.

FAST'S FLEXIBLE COUPLING

DESCRIPTION

An all-metal, flexible coupling of the double-engagement type, designed for positive lubrication and meeting the most exacting service conditions —from the simple installation of a blower to that of the largest steam turbine driven generator or huge steel mill reversing drives, and able to transmit power at high or low speed with equal effectiveness.



FAST'S FLEXIBLE COUPLING
Self-contained, lubricated and dustproof

The sectional view shows the mechanical principle. Two generated spur gears, one on each shaft end, are continually and completely meshed in oil with the internal gears of a floating sleeve. The shafts and sleeve revolve as one unit, allowing the connecting sleeve free lateral and angular play.

It is a "self-aligning" coupling and does not depend upon the flexibility of rubber, leather, fiber or laminated pins. Therefore, its life is not governed by the fatigue of materials. It derives its flexibility from a simple, mechanically correct principle.

SECTION OF FAST'S COUPLING

Complete illustrated catalogue, giving full data and prices, sent on request.

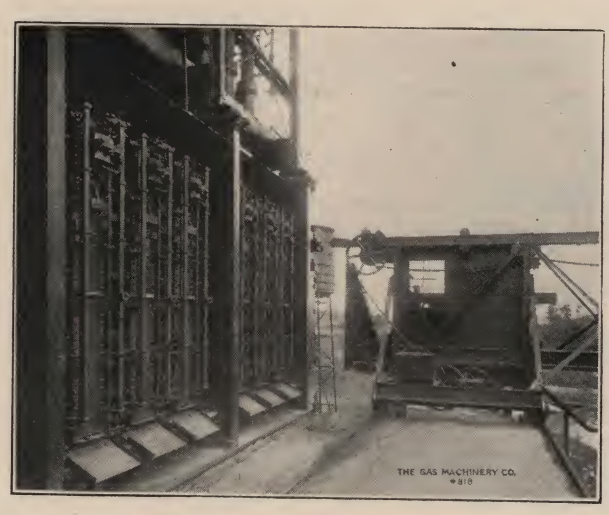
THE GAS MACHINERY COMPANY

Cleveland, Ohio

New York Office, 812 Graybar Building — E. E. Witherby, Eastern Representative

PRODUCTS:

Ammonia Sulphate Apparatus; Aqua Ammonia Apparatus; Gas Works Apparatus; Coal Gas Benches (Silica Retorts); Ammonia Liquor Concentrators; Condensers; Naphthalene Extractors; By-Product Gas Ovens; Oil Gas Plants; Water Gas Plants; Breeze Collectors for Water Gas Stacks; Automatic Controls; Gas Producers; Purifiers; Power Driven Pressure Regulators; Ammonia Scrubbers; Cooling Scrubbers; Cooling Coils; Tar Stills; Tar Extractors; Valves; Ammonia Washers; Tar Washers; Exhaust Steam Accumulators; Waste Heat Boilers; Welded Steel Pipe and Fittings.



BY-PRODUCT GAS OVENS

Gas ovens produce the best grade of coke commensurate with lowest initial investment, minimum of labor, lowest cost of maintenance and repairs.

A complete water gas plant which we recently constructed is shown at the bottom right; the legend under the cut will give an idea as to the service which accompanies any project that we undertake to handle in its entirety. Our chief aim is to provide our clients with equipment most adaptable to their requirements.

Our Engineering Staff is always ready to lend any assistance in the selection of apparatus that will increase the profit on the sendout by saving in the cost of production.

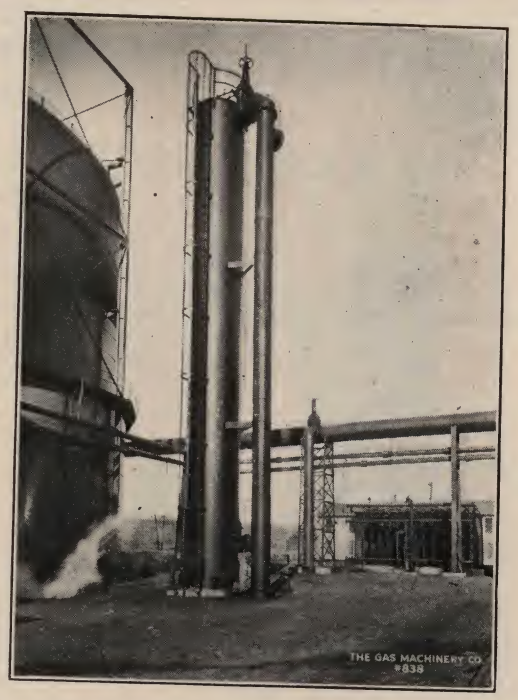
Bird's eye view of a plant, showing the purifiers and tar and liquor separator in the foreground; the machinery room, cooling scrubber, relief holder, generator and boiler room, boiler stack in the center; and the water cooling tower, the condenser for high pressure gas and the coal handling trestle in the background.

WASTE HEAT BOILER STEAM CURTAIN

Double Gate Hot Gas Valve for Carburetted Water Gas

Placed between the superheater outlet of a water gas set and the inlet of a waste heat boiler. One waste heat boiler may be used for two or three sets by using one steam curtain valve at the outlet of each superheater and connecting same into a common header leading to waste heat boiler.

No stack valve is required at outlet of boiler. (Patent allowed.)



This cooling scrubber with cooling coils is installed to cool and scrub carburetted water gas.

The cooling liquor is recirculated through the cooling coils, over which cold water is passed.

This offers the most efficient type of condensing and scrubbing.

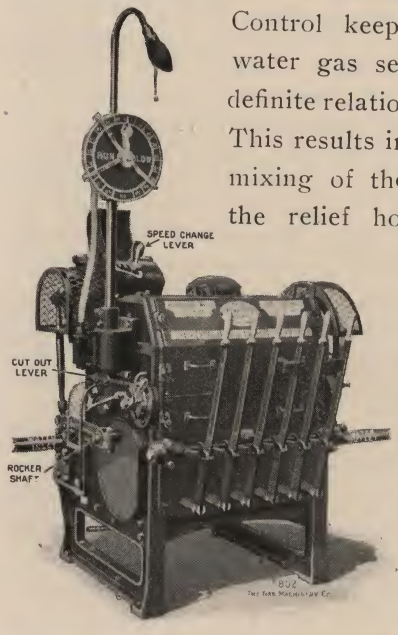
AUTOMATIC WATER GAS CONTROL

(Patented June 10, 1924)

Our Automatic Control is so widely known as to require no detailed description.

MASTER CONTROL

We have developed a Master Control to keep a number of water gas sets individually equipped with automatic controls "in step." The Master Control keeps the individual water gas set operating in a definite relation with the whole. This results in a more uniform mixing of the make gases in the relief holder, also minimizes required capacities of boilers and blowing equipment, and permis the use of smaller connections to the relief holder.



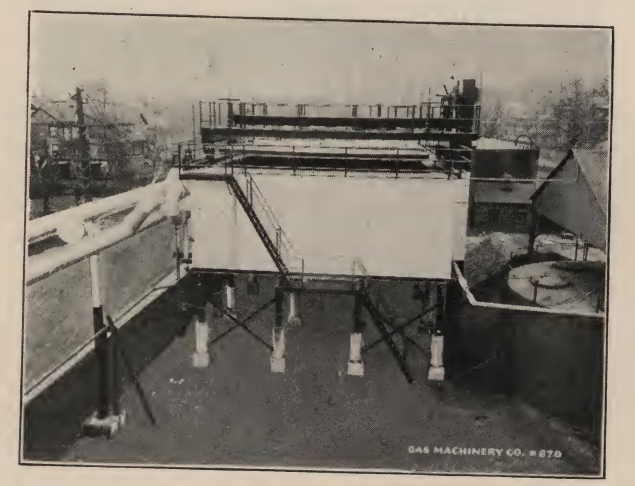
PURIFIERS (Cut Shown Below)

The steel purifying boxes illustrated below are completely fabricated and arc welded in the field.

Oxide for filling is handled into the boxes by a bucket elevator conveyor which is mounted on the gantry crane used for lifting and transporting covers.

The bucket elevator discharges into a screw type conveyor also carried on the gantry crane and running in a trough provided with discharge gates; by means of this combination the oxide may be discharged into practically any part of the box.

Spent oxide is discharged through self-sealing doors in the bottom of the boxes.



THE U. G. I. CONTRACTING COMPANY

DIVISION OF

UNITED ENGINEERS & CONSTRUCTORS

INCORPORATED

BROAD AND ARCH STREETS

CHICAGO PHILADELPHIA NEW YORK

U. G. I. EQUIPMENT AND SERVICE

PRODUCTS:

- Mechanical Water Gas Generators
- Vertical Chamber Ovens
- Carburetted Water Gas Plants
- Blue Gas Apparatus
- Producer Gas Plants
- Waste Heat Boilers
- High Duty Gas Condensers
- Cottrell Electrical Precipitators
- Heavy Oil Nebulizing Systems
- Combination Blue and Coal Gas Plants to Replace Natural Gas
- Steam Accumulators
- Air and Steam Controls
- Cyclonic Dust Catcher
- Pier Process

U. G. I. VERTICAL CHAMBER OVENS

The U. G. I. Vertical Chamber Oven is a development of the U. G. I. Intermittent Vertical Retort wherein the units of three retorts are combined into one large chamber. The same fine regulation of heats is maintained and the operating process is simplified.

U. G. I. Vertical Chamber Ovens

The coal and coke are handled by gravity and without heavy charging or discharging machinery.

The coke produced is of large size and fine quality and the gas, tar and ammonia production and efficiency are equal to any other type of oven. Likewise, the ovens are capable of being steamed, thereby increasing capacity and ammonia yield.

The U. G. I. Vertical Chamber Ovens are reasonable in cost of installation, are adapted to large as well as small plants and are easily operated at low labor cost.

U. G. I. MECHANICAL GRATE GENERATOR

The U. G. I. Mechanical Grate Generator with Automatic Charger embodies the fundamental design of the U. G. I. Pressure Producer which has been in successful operation for many years.

The U. G. I. Mechanical Grate Generator with Charger now provides a safe and efficient self-clinkering water gas generator, wherein no manual labor whatsoever is required for clinkering or barring down, and wherein the production of water gas is continuous, since all shut-downs for coaling and clinkering are eliminated.

The generator shell embodies an annular water vessel which forms part of a steam boiler surrounding the lower portion of the fuel bed and including the clinker adhesion zone. A steam drum is connected directly with this water vessel so that the combination of the two forms a steam boiler. The generator shell above the water jacket is lined with firebrick and insulating material.

The grate is of the eccentric rotating cone stepped type. By its rotation the fuel bed is agitated and any clinker formation crushed. Plows direct the ashes into hoppers, from which they are periodically removed without interruption to the operation of the generator.

The U. G. I. Automatic Fuel Charger is mounted on top of the generator and is hydraulically operated. Fuel charging is accomplished without interrupting the operation of the generator.

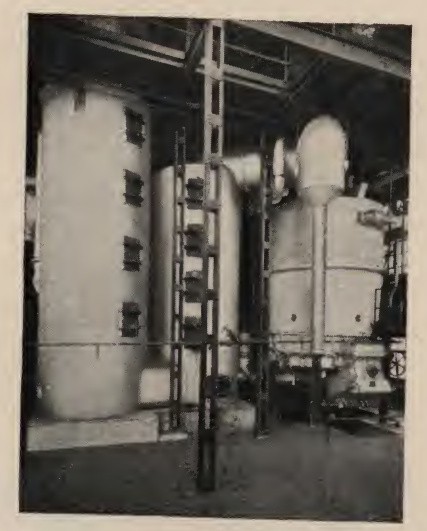
The U. G. I. Mechanical Grate Generator and Automatic Fuel Charger has the following advantages:

1. Uniformly active and efficient fuel bed by reason of the even travel of the clinker and ash to and out of the bottom of the generator.

2. Uniform rate of gas production because set is continuously operated without shut-downs for coaling, cleaning or barring down.

3. Saving in clinkering labor, as cleaning and clinkering labor is entirely eliminated.

4. Production of low pressure steam by and for the use of the generator. This steam provides for a large proportion of total amount required for the gas production. This saving of steam may approximate 20 lbs. per M.c.f. of gas made, or over half of the total required.



The U. G. I. Mechanical Grate Generator

5. Savings in generator lining repairs because the lower part of the generator is water jacketed, without linings. This is the portion which is responsible for most of the lining repair costs.

6. The amount of combustible lost with the ash is practically negligible.

The entire construction of the U. G. I. Mechanical Generator and Automatic Charger is most rugged. There is freedom from mechanical troubles and it is truly self-clinkering.

THE U. G. I. VERTICAL RETORTS

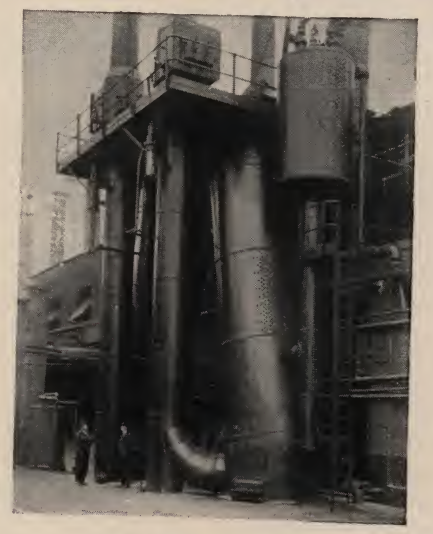
U. G. I. Vertical Retorts are of the intermittent type of operation, particularly suited to American coals and have been demonstrated as the most successful retort plants operating in the United States today, providing the simplest and easiest method of coal carbonization and producing high yields.

U. G. I. Vertical Retorts may be heated either by attached or detached producers.

WASTE HEAT BOILERS

U. G. I. Waste Heat Boilers utilize the sensible heat of the gases from carburetted water gas apparatus, coal gas settings, blue gas apparatus, producers, or any other situation where sufficient waste heat is available.

U. G. I. Waste Heat Boilers have long since established their position as efficient and economical equipment. They can be installed either indoors or outside.



U. G. I. Waste Heat Boiler

CARBURETTED WATER GAS

In the art of carburetted water gas manufacture we hold the pre-eminent position, being the pioneer developers and builders. U. G. I. Carburetted Water Gas Apparatus represents the best in scientific design and fabrication, based upon intelligent research and our own Physical Laboratory experimentation.

Cheapness is not the governing factor in U. G. I. apparatus, but rather that of producing apparatus which will give the best results and maintain operating and repair costs at the lowest possible minimum. Late developments include the Pier Process, which is the successful method of soft coal operation, the Chrisman Cycle, the Mechanical Generator and the Cottrell Electrical Precipitation System for gas cleaning.

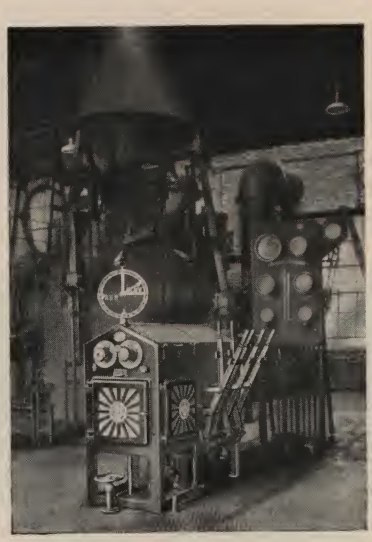
U. G. I. Carburetted Water Gas Apparatus

AUTOMATIC CONTROL OF WATER GAS APPARATUS

The automatic operation of water gas apparatus was conceived and developed by U. G. I. engineers, and their ideas, taking form in the U. G. I. Automatic Control, passed through the strictest tests and criticism before winning the confidence of its users and establishing itself as the standard reliable equipment for the operation of water gas apparatus.

By the use of the U. G. I. Automatic Control, appreciable savings are effected and the water gas apparatus is operated with greatly increased efficiency. By its use generator fuel is saved and the fuel bed maintained in better condition, producing a uniform quality of gases and a softer clinker which can be easily and quickly removed. The automatic control permits of shorter cycles, which in turn results in more uniform temperatures in the carburetter and a more complete and effective gasification of the oil.

Because of the elimination of hand operation, less labor is required. Higher capacity is obtained with gas apparatus because time losses are practically eliminated. With uniform temperature in the fuel bed, more perfect demolition of the steam is obtained. The actual gas-making time is increased because the time required to clean the fires is reduced on account of a softer clinker formation.



The U. G. I. Automatic Control

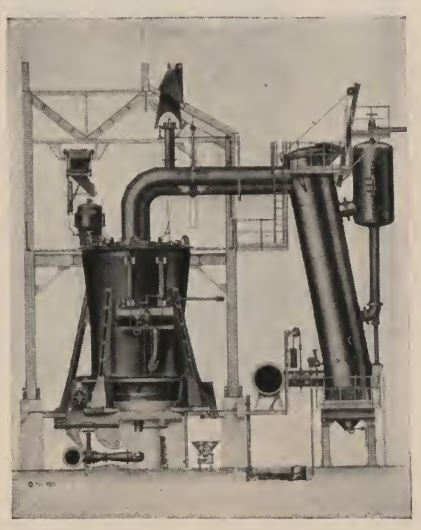
U. G. I. PRESSURE PRODUCERS

U. G. I. Pressure Producers, like the reputation of U. G. I. Water Gas Apparatus, etc., did not spring up over night. The art of producer gas manufacture was studied from every angle; the mistakes and pitfalls were carefully considered and charted so that when our engineers began their design and development of the U. G. I. Pressure Producer the weak points of the past were avoided.

In a field where competition is keen and claims are frequently made and accepted, the U. G. I. Pressure Producer stands out as more nearly approaching mechanical perfection than any other type.

The U. G. I. Pressure Producer is a self-feeding, self-cleaning unit, which may be run continuously without any other operation labor than the supervision that would be given to any live apparatus. For fuel it uses coke of nut size and smaller, which fuel is always available and usually obtained at prices considerably lower than that of other fuels.

The construction of the U. G. I. Pressure Producer is unique in that the zone of activity is water-jacketed, in-



The U. G. I. Pressure Producer

stead of being firebrick lined. By this feature, the heat from the fuel bed which would otherwise be lost, is transmitted to the water in the jacket and generates low pressure steam for use in the producer itself. The water jacket and lack of firebrick lining likewise eliminate clinker troubles within the producers.

The grate is set eccentric to the vertical axis of the producer and is of the step-cone type. This grate revolves and acts as a powerful crushing medium for the ash, and an ash plough removes same without interfering with the operation of the producer.

Producer gas may be put to innumerable uses where a heating medium is required. It is used for the heating of carbonizing plants, in the steel and ceramic industries and wherever a clean, cool gas having a heating value of approximately 125 B.t.u. is needed.

THE CHRISMAN CYCLE

The Chrisman Cycle may be installed on any three-shell water gas apparatus. The only change required consists substantially of removing the reverse steam connection, if set previously had been so equipped, and

running a connection from the bottom of the generator to the washer. No change is made in the usual method of operation.

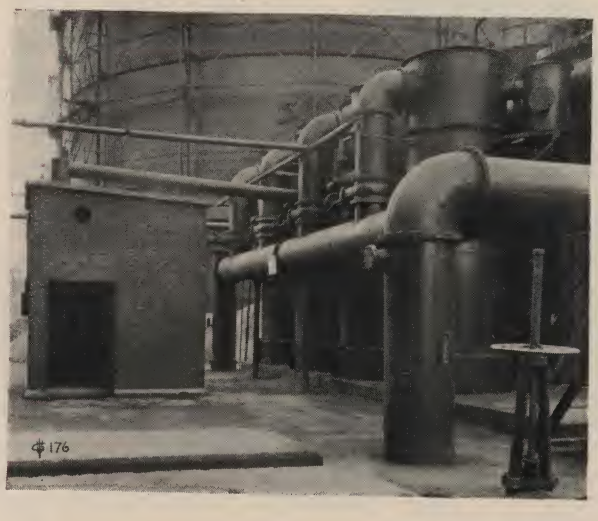
Outstanding economies are derived from removing the down-run blue gas at low temperature and not having to provide heat in the carburetting vessel for heating this blue gas. There is a consequent reduction in the amount of air blast required.

A large number of installations of the Chrisman Cycle have been made to date with various plants throughout the country, with a consistent and uniform saving of about 3 lbs. of generator fuel and about 10 per cent increase in set capacity.

THE COTTRELL ELECTRICAL PRECIPITATION PROCESS

The Cottrell Electrical Precipitation Process, for the removal of suspended tar from gases, consists essentially of a multiplicity of pipes or tubes, constituting grounded electrodes, with central or axial electrodes, electrically insulated from the rest of the apparatus and negatively charged to a high potential.

In the intense electric field thus maintained, there is a corona (or silent) discharge from the negatively charged



Cottrell Electrical Precipitation Process

electrode to the grounded pipe. When fuel gases traverse the pipe through the electric field, the foreign matter in the gas is precipitated upon the interior of the pipe and removed. The gas emerges clean.

While the voltage used is high, the current consumption is so small that danger of short circuits releasing large amounts of energy is negligible.

This Process is very successful, is a cheap one to operate, is simple and is absolutely safe in operation.

CONSULTING ENGINEERS

In employing the services of United Engineers & Constructors Inc., our clients avail themselves of an organization that can assume the undivided responsibility of contracts for Appraisal, Design, Engineering and Construction. The facilities of this organization enable it to undertake the most difficult engineering projects and bring them to a satisfactory conclusion with the utmost economy and speed.

Every department is supervised by men who are nationally recognized authorities in their particular fields, many of whom have been associated with the organization for a quarter of a century or more. Others are experts recruited from the industrial world whose progress and achievements warranted their connection with this company.

INVENTORIES AND APPRAISALS

United Engineers & Constructors Inc. is especially equipped to examine utility and industrial properties, prepare inventories and appraisals, make detailed analyses of rate structures, and present expert testimony before state and municipal regulatory bodies.

This type of service, covering every phase of the utility business, has been rendered to many companies located in all parts of the United States.

GENERAL ENGINEERING AND CONSTRUCTION

United Engineers & Constructors Inc. holds a firmly established position as designers, engineers and builders. Having the financial responsibility and the organization to undertake work of any magnitude, it has a record of imposing work well done.

The company has designed and constructed—in all parts of the United States and many foreign countries—the following classes of work: Electric power stations—both hydro and steam, sub-stations, transmission systems, dams, locks, railroad shops, freight terminals, locomotive and passenger terminals, coaling stations, bridges, piers, tunnels, roads, office buildings, hospitals, hotels and apartment houses, factories and industrial buildings, textile mills, chemical plants, sugar refineries, smelters, lead plants, fertilizer plants, lumber mills, steel mills, foundries, tanneries, filtration and disposal plants, pipe lines and pumping stations, harbor and dock works, warehouses.

With this background of wide experience and proficiency, United Engineers & Constructors Inc. stands ready to deliver maximum return to its clients per dollar expended.

CONNELLY IRON SPONGE & GOVERNOR CO.

MANUFACTURERS OF GAS WORKS APPARATUS AND PURIFYING MATERIALS

Plants: Elizabeth, N. J. — Long Island City, Chicago, Ill.

General Offices: 14th Street and Marion Place, Long Island City, N. Y.

Southern Industrial Eng. Co., Birmingham, Ala., Southern Representative

PRODUCTS:

IRON SPONGE
Gas Purifying Material

GOVERNORS
1. Station — Automatic, Balance
2. District — Liquid Seal, High Pressure, Intermediate Pressure, Low Pressure
3. Retort House
4. Fuel Gas or Coke Oven
5. Bypass or Reverse Flow
6. Service — Liquid Seal, High Pressure, Intermediate Pressure, Low Pressure

EXHAUSTERS

BOOSTERS

RESPIRATING AND FIRST AID OUTFIT

GAUGES (Siphon, Pocket, Thorp and Differential)

GAS TAPE

GAS MAIN BAGS

STREET DEPARTMENT REQUISITES

FLOOR HARDENER

PURIFYING MATERIAL—Iron Sponge, Precipitated, Red Ore, Special Oxide.

Iron Sponge, the standard material for purifying gas, universally used because of its dependability.

Precipitated, for extraordinary cases where boxes are small and revivification necessary. Will not heat to high point.

Special oxide, for special purification of gas, as in industrial plants.

These materials are used by the majority of Gas Companies.

Economical and efficient. Bulletin No. 2.

AUTOMATIC STATION GOVERNOR

This Governor, shown in phantom view, automatically maintains predetermined pressure, always in proportion to the amount of gas sent out. The time consumed by the Governor in changing the minimum to the maximum pressure can be regulated at will. Bulletin No. 1-H.

CONNELLY BALANCE GOVERNOR

This Governor changes the volume of gas sent out, without losing uniform pressure at the outlet. Desired changes effected by adding or removing weights manually.

Bulletin No. 2-H.

TYPE L. C. DISTRICT GOVERNOR

Can be submerged without affecting its operation. No auxiliaries. No stuffing boxes. Completely enclosed self-contained unit. 5 inches to 100 lbs. inlet pressure. Bulletin 2-D.

MERCURY SEAL GAS GOVERNOR

Features

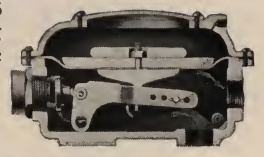
1. Complete submersion without affecting operation.
2. No stuffing boxes; no auxiliary governors or lever arms.
3. Shipped *en bloc,* completely assembled, ready for installation.
4. Controls Holder or Booster pressure up to and within five pounds per sq. in. Sizes from 3" to 20" inclusive.
5. No diaphragms to be maintained. Inlet pressure up to ten pounds.

Bulletin 1-D.

CONNELLY SERVICE GOVERNOR, TYPE L. C.

Controls inlet pressure from 5 inches to 50 pounds, maintaining any desired outlet pressure. Made in ½ in. to 3 in. pipe sizes.

Bulletin No. 1-S.



CONNELLY BACK PRESSURE VALVE

Safety, the most needed feature of gas appliances, is always present with this valve. Its *positive check* against reverse flow is effective in any emergency while its *automatic* action is sensitive to the slightest pressure.

Bulletin No. 1-B.

CONNELLY H_2S GAS TESTER

Designed to meet all requirements. Practical, convenient. It is intended to take the place of the variety of devices heretofore used.

THE COUNTERBALANCED CAST IRON MANHOLES

have been adopted as standard practice and are extensively used for Gas Main Pits by the Gas Companies all over the country. Bulletin 18-LX.

MILLER GRIP PACKING

Every Joint is an expansion Joint that is flexible and permanently tight; impervious to oils or change of temperature. Vibration or ground movement does not affect a Joint, heavy traffic and shock absorbing.

GAUGES

Our Differential Pressure Gauge, Superintendent's Pocket Gauge, and Sterling Siphon Pressure Gauge, all designed for the most practical work, possess unusual merits. Sizes from 4 in. to 60 in.

Bulletin 1-G.

THE JONES JET PHOTOMETER

A practical instrument for determining candle power. Supplied with bracket and tip and adaptable to all kinds of gas. Bulletin No. 8.

Bulletins describing other Connelly apparatus sent upon request

THE KOPPERS CONSTRUCTION COMPANY

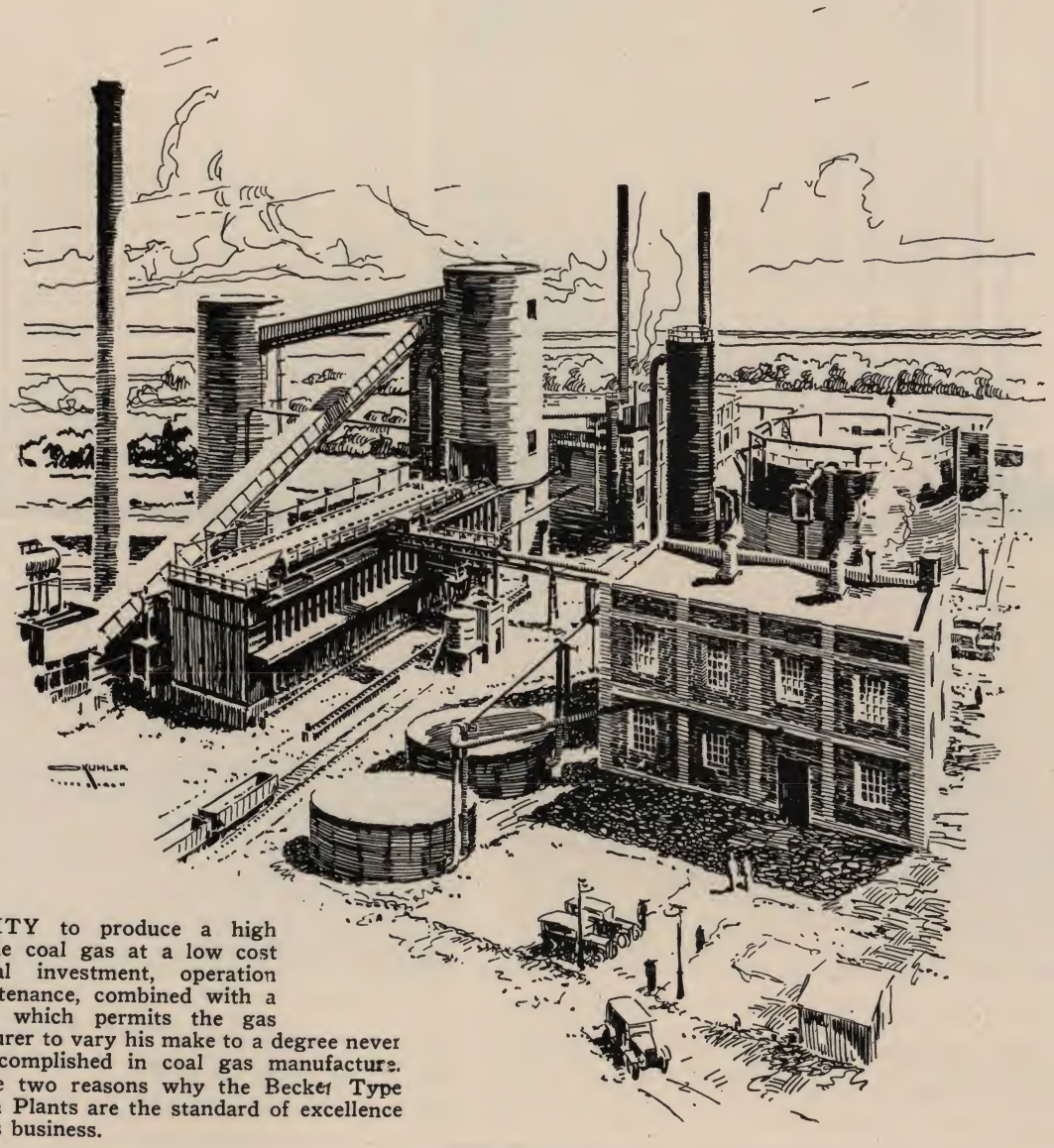
Designers and Builders of By-Product Coke and Gas Plants

PITTSBURGH

Chicago **New York**

PRODUCTS:

Apparatus, Ammonium Sulphate (Koppers Patented Direct Process).
Apparatus, Sulphur Purifier, Koppers Liquid Gas Purification Process.
Apparatus, Concentrated Ammonia Liquor.
Plants, Benzol Recovery.
Plants, By-Product Coke and Gas Oven.
Plants, Material Handling
Plants, Naphthalene Removal.
Plants, Continuous Vertical Oven.
Plants, Coal Gas.
Plants, Concentrated Ammonia Liquor.
Plants, Koppers Liquid Gas Purification.
Plants, Motor Fuel Recovery.
Plants, Tar Distillating.
Plants, Water Gas.
Plants, Blue Gas.
Producers, Gas.

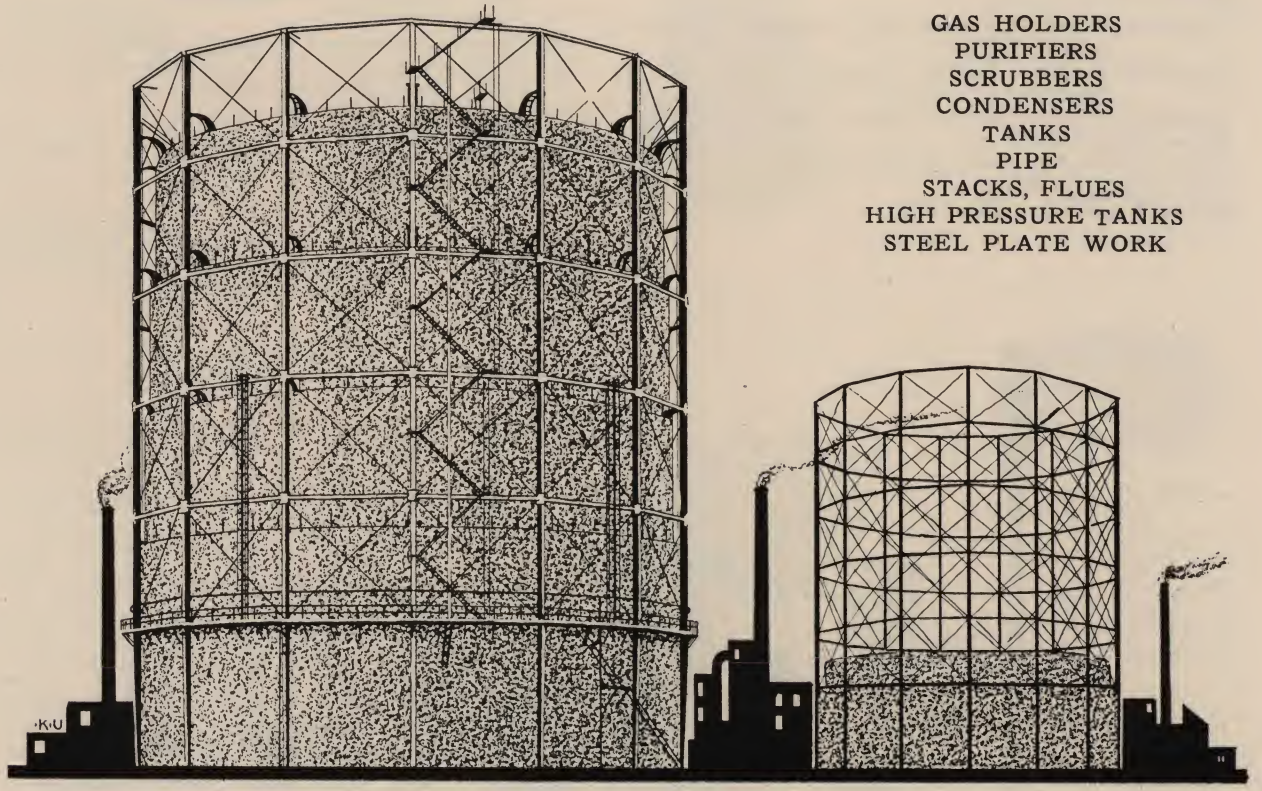


ABILITY to produce a high grade coal gas at a low cost for initial investment, operation and maintenance, combined with a flexibility which permits the gas manufacturer to vary his make to a degree never before accomplished in coal gas manufacture. These are two reasons why the Becker Type Gas Oven Plants are the standard of excellence in the gas business.

CRUSE-KEMPER COMPANY

MAIN OFFICE AND WORKS, AMBLER, PA.

Engineers **Contractors** **Manufacturers**



GAS HOLDERS
PURIFIERS
SCRUBBERS
CONDENSERS
TANKS
PIPE
STACKS, FLUES
HIGH PRESSURE TANKS
STEEL PLATE WORK

In a single product—the Gas Holder—is a picture of the Cruse-Kemper Company and the qualities that enter into every kind of equipment the company supplies.

Just as each new Gas Holder embodies the latest scientific developments in the Gas Industry, so Purifiers and High Pressure Tanks are designed in keeping with our constantly perfecting knowledge.

The fundamental strength that enables the Gas Holder to maintain high records of performance through years of service is the same fundamental strength found in Stacks and Bins and other products based on the use of Steel Plates.

The care in construction that leads to a permanently leak-proof installation is likewise paralleled in the manufacture of Riveted and Welded Pipe, Tanks, Flues and Mains.

Under twenty-five separate equipment headings the Cruse-Kemper Company is listed on the directory pages of this Catalog. Associate with the name the excellent service of the scores of Gas Holders now in use throughout the country. The skill in design, the choice of materials and the workmanship that have created the company's excellent Gas Holder record will carry over to all other products made by the same hands.

The Stacey Bros. Gas Construction Co.

CINCINNATI, OHIO

ENGINEERS AND BUILDERS OF GAS HOLDERS AND GAS PLANT EQUIPMENT

J. E. STACEY, President
WAYNE STACEY, Gen. Sales Manager
A. J. STACEY, Vice-President
W. A. MILLER, Chief Engineer
A. L. POPE, Secretary and Treasurer
P. C. RODGERS, Asst. Gen. Sales Manager

New York Office
P. F. McENANEY, Eastern Sales Mgr.
75 West Street

New England Representative
EASTERN SERVICE COMPANY
Boston

PRODUCTS: GAS HOLDERS, "STACEY BULLET" HIGH PRESSURE HOLDERS, PURIFIERS, TANKS, STANDPIPES, PEN STOCKS, SCRUBBERS, CONDENSERS STACKS, STEEL PLATE CONSTRUCTION.

Stacey Brothers' **"Ability to Serve"** is nationally recognized, not only because of advanced and substantial design and accurate fabrication, but also because of the high quality of workmanship performed by our many skilled field erectors and the extreme smoothness and speed with which work is completed.

Gas holders are capital investments and holders by Stacey Bros. assure a long life for that investment. It is real economy to buy Stacey Bros. Holders and they can be supplied in any capacity.

Above illustration shows ten million cubic foot holder erected in Buffalo, N. Y., and a duplicate erected in Long Beach, Cal. Another ten million cubic foot holder now being erected in San Francisco, Cal., for the Pacific Gas & Electric Co.

Stacey Bullet

A pressure holder of unlimited capacity, unsurpassed for sound engineering and designed to eliminate faults inherent in other types. It is attractive in appearance, low in cost and is the result of years of experience in gas engineering.

Purifiers

Designed on a conservative basis and users are assured cheap operation and maintenance. The capacity is calculated to purify gas at a minimum of cost.

The Stacey Bros. are the Pioneer Gas Holder Builders of America

PARKER-RUSSELL CO.

ST. LOUIS, MO.

ENGINEERS–CONTRACTORS–MANUFACTURERS

PRODUCTS

COMPLETE COAL CARBONIZATION PLANTS

GAS BENCHES
GAS OVENS
VERTICAL CHAMBER OVENS
FIRE CLAY RETORTS
SILICA RETORTS
WATER GAS LININGS
CHECKER BRICK
SILICA SHAPES
FIRE CLAY SHAPES
SPECIAL REFRACTORY SHAPES

PARCO GENERATOR LINING BLOCKS
PARCO HIGH TEMPERATURE CEMENTS

Q-ALLOY HIGH HEAT RESISTING METALS

GAS FIRED INDUSTRIAL FURNACES

VENTILATED PRODUCER WALLS

MANUAL AND ELECTRICAL PUSHING MACHINES

COMPLETE DISTRIBUTION SYSTEMS

SOLE AGENTS FOR

DEUTSCHE OFENBAUGESELLSCHAFT

Vertical Chamber Ovens

Eitle Charging and Discharging Machines

Congdon Scrubber Standpipe System

Fiddes-Aldridge Simultaneous Discharging-Charging Machines

THE STACEY MANUFACTURING COMPANY

J. FRANK STACEY, Pres. & Gen Mgr.
GEO. H. CRESSLER, Gen. Sales Mgr.

A. A. RANSHAW, Vice-Pres.
W. D. BIRBECK, Sales Engr.
A. E. HARVEY, Sales Engr.

EDW. J. BAECHLE, Sec'y & Treas.
FRANK O. PANDORF, Chief Engr.

Established 1851 **CINCINNATI, OHIO** *Incorporated* 1880

New York Office: 52 Vanderbilt Ave. Telephone Vanderbilt 1549

GAS HOLDERS

GAS PLANT EQUIPMENT

PURIFIERS

STEEL TANKS

CAST IRON VALVES AND FITTINGS

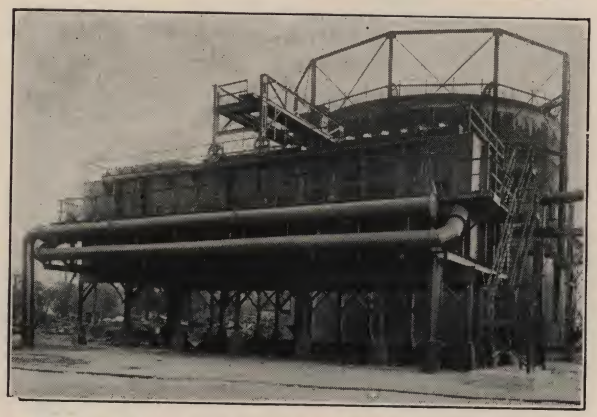
WELDED STEEL PIPE AND FITTINGS

Builders of More Than 1300 Gas Holders

STACEY SINCE 1851

Pioneer Builders of Low and High Pressure Gas Holders

STACEY SINCE 1851



THE STACEY MANUFACTURING COMPANY

The Builders of* STACEY *Gas Holders for Seventy-Eight Years

INDUGAS COMPANY, Inc.

114 LIBERTY STREET - NEW YORK

PRODUCTS: By-Product Plants for the Extraction of Tar and Ammonia and Recovery of Benzol; Coal-Gas Apparatus; Coal and Coke Handling Machinery; Complete Gas Plants; Gas and Coke Ovens; Vertical Retorts; Producer Gas Plants; Tar Distilling Plants; Gas Purification Plants (Liquid Process).

THE CARL STILL REGENERATIVE MULTI-STAGE HEATED BY-PRODUCT COKE OVEN

In the special arrangement developed for underfiring, the heating gases and air for combustion are *divided and proceed successively and uniformly at different elevations in the heating flues.*

The air, instead of entering as formerly, in a single undivided mass at the base of the flue, *is supplied in predetermined quantities,* and *is divided over the height of the flue,* while the gas enters in one stream through a jet provided at its base.

The division of the whole current of air is simply accomplished by means of vertical channels provided in the dividing walls separating the flues. Lateral ducts lead into the adjacent flues and serve as injectors for *specific quantities of air* at *specified elevations.*

THE COMBUSTION PROCESS

The gas coming from the channel and entering the bottom of the heating flues through gas-jets comes in contact with *only a part* of the entire combustion air admitted through the lowest pair of air ducts, located on the same level with the gas-jets.

This portion of the air, which is insufficient for the complete combustion of the entire volume of inflowing gas, serves to burn only a *proportionate quantity* of the heating gas. The remaining unburned gas, together with the waste gases of the lowest combustion stage, flows upward in the heating flue.

At the next air duct, arranged at a *specified higher level,* the unburned gas comes in contact with a *second portion* of the air, and again partial combustion takes place. The process continues until the highest and last air duct is reached, and there the *remaining air is consumed* in *burning the remainng gas.*

This concludes the process, and combustion is *complete* because both *gas and air are supplied in the required volumes.* Excess of air is practically precluded; only traces of oxygen are found in the horizontal channel.

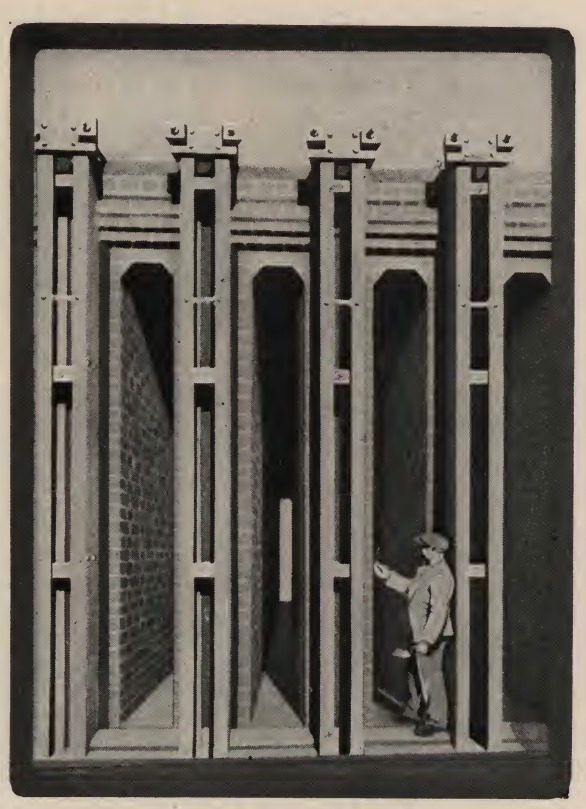
Variations in Temperature over entire Battery less than 2%.

Average about 800 B.t.u. per pound of dry coal.

Coal Charges—24 to 30 tons of coal.
Breeze or Fine Coke less than 3%.

Coking Time—12 to 14 hours.

Greatest production per unit of labor



THE "INDUGAS" SYSTEM OF VERTICAL CHAMBER OVENS

—INTERMITTENT TYPE—

With Water-Sealed Drop Door

This system embodies the accumulated experience of many years construction of both Gas Works and Coke Ovens. The best features of both are combined and represented in its development.

SILICA OVEN CHAMBERS

Silica bricks are used in building the chambers because of their high heat resistance, their increased capacity for heat transmission and greater hardness and stability. Ovens can be operated at the highest temperatures without danger of overheating the walls.

HIGH OVEN TEMPERATURES

The operation of the ovens under high temperatures permits quick coking of the coal, consequently a large through put. Rapid progression of coking is induced by the superior heat transmission of the silica bricks.

INCREASE IN GAS YIELD

The water used in sealing the lower chamber drop doors is heated and partly evaporated by the heat radiating from the chambers and from the hot coke. This steam rises in the interior of the chamber and forms water gas, so that *even without the special injection of steam* a material increase in the yield of gas takes place, which is produced *without extra cost,* since the heat used for evaporating the water would be lost by radiation in the case of a dry door closing mechanism.

LARGE GAS YIELD

Operating results of the "INDUGAS" chamber-ovens show that the gas production can be considerably increased as a result of this effective generation of water gas, retaining at the same time a comparatively high heating value. At the Gas Works, Baden, Switzerland, the yield during 1926 averaged 14,190 cu. ft. with a gross heating value of about 560 B.t.u. At the same time the content of incombustibles in the gas, that is, nitrogen and carbonic acid, did not average more than 7%—a proof of the excellent generation of water gas and the tightness of the chamber walls.

12 AND 24 HOUR CARBONIZATION

The chamber ovens are designed for 12 and 24 hours coking time, the width of the chamber being of either smaller or larger dimensions. The advantage of the 24 hour coking time is in the reduction of labor in connection with the charging of the ovens, since the ovens have to be charged only once per day; the disadvantage, on the other hand, is to be found in a somewhat higher capital investment and in the larger variations in the heating value, since the quality of the gas discharged from the coal during the first hours of carbonization is naturally better than during the last hours. The heating value of the gas is more uniform in the ovens operated at a 12 hour coking time, so that in cases where only limited holder-capacity is available for the mixing of the gas, the 12 hour period is preferable. The auxiliary equipment for handling of coke from 12 hour operation is also lighter and cheaper, since the quantities to be handled at a time are smaller.

ECONOMY OF THE "INDUGAS" SYSTEM

The pronounced economy of our Chamber Ovens as compared with retort benches is due to:

(1) Saving of labor.

(2) Larger gas yield from the coal.

(3) Larger yield of saleable coke and better quality of coke.

(4) A more fluid and valuable tar.

Descriptive literature of any of the foregoing products will be sent on request.

C. W. HUNT CO., Inc.

West New Brighton, Staten Island, N. Y. C.

Representatives

PHILLIPS, LANG & CO., INC.,
431 South Dearborn St.,
Chicago, Illinois

ENGINEERING EQUIPMENT CO., Ltd.,
358 Beaver Hall Square,
Montreal

ERNEST F. LEARNED,
141 Milk St.,
Boston, 9, Mass.

Products:

Conveyors; Skip Hoists; Quenching Chutes; Weighing Larries; Motor Operated and Push Cars; Electric Mine and Industrial Locomotives; Automatic Railways; Cable Railways; Switches; Industrial Railroad Tracks; Coal Crackers; Bin and Hopper Gates; Cut-off Valves; Scales; Weighing and Measuring Devices; Coal Tubs; Rope Couplings; Drilling Cable; "Stevedore" Hoisting and Manila Transmission Rope; Mitchell Electric Vibrating Screens.

CO-OPERATIVE SERVICE

Since every coal or other bulk materials handling, or railway proposition has specific requirements and conditions to meet, our engineering staff is at the disposal of all parties interested in the above classes of work. It will gladly advise, recommend, or furnish estimates.

FACILITIES

Standard parts most in demand are carried in stock. The company's resources, including plant, capital and engineering force, are prepared for prompt action on the largest special requirements. Prompt deliveries are further assured through exceptional shipping facilities—Baltimore and Ohio R. R. tracks on the property and wharf accommodating the lighters of every railroad centering in New York City.

INDUSTRIAL RAILWAY AND EQUIPMENT

TRACKS—MADE UP—Made in sections, 20 ft. long of standard light rails riveted to cupped or flat steel ties. Ties spaced 24½-in. centers and 7½ in. from ends. Special lengths to order.

Fig. 2.

ROLLED STEEL AND CAST PLATE CURVES

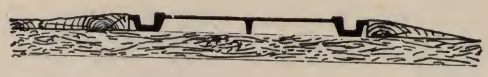


Fig. 1. CAST PLATE STRAIGHT TRACK
Sectional View

KNOCKED DOWN—Made in sections 15 ft. long of standard light rails, bolted up in field to special cross ties with clips and bolts. Special lengths to order.

CAST PLATE—Track cast integral with plates and made in standard lengths up to 5 ft. (Fig. 1.)

CURVES—Hunt short radius curves are made with a special guard rail, which in conjunction with Hunt special running gears eliminate friction when cars are rounding sharp curves.

Fig. 3. LEFT-HAND SWITCH WITH STAND

Fig. 4. TWO-WAY SWITCH

Fig. 5 RIGHT-HAND SWITCH

SWITCHES

Left-hand, right-hand, 2-way or 3-way, with or without stands. Also can be furnished in cast plate (Figs. 3, 4 and 5). Frogs, crossovers and turntables are also manufactured. Any workman of ordinary intelligence can put together a whole system ready for use.

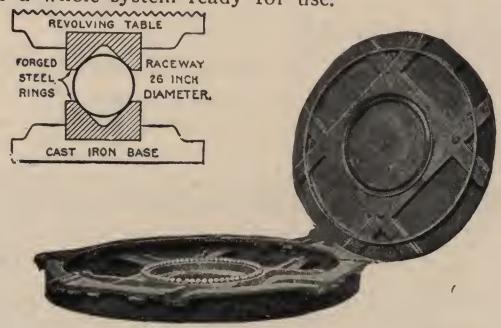
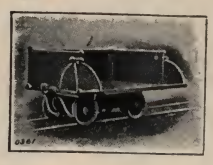


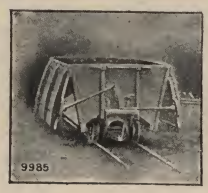
Fig. 7. TURNTABLE WITH SKETCH SHOWING CONSTRUCTION OF BALL BEARING

CARS

Bodies of various designs to meet a wide range of use, but all have essentially same truck construction. Axle bearings are either plain or roller bearing. Arrangement of running gear (Fig. 9) facilitates propulsion on short curves. Standard width for clearance of cars is 4 ft. Curve radius 12 ft.



Standard Charging Car



Standard-4-wheel Self-dumping Push Car

Standard Tip Car.

TRACK SCALES

Made in both iron and wooden frames, especially designed for use with industrial railway, track ends connecting directly with either cast plate or made-up steel track of railway system.

Both types of scales are provided with a tare beam to balance weight of empty cars so that load beam will give net weight of load. Beams are furnished graduated to pounds or kilograms as desired.

HUNT CONVEYORS

The Hunt pivoted bucket conveyor carries bulk material, dry or liquid, noiselessly in any direction without shock, breakage or violence. Three types of conveyors are manufactured: "Standard," with independent buckets, being separately filled; "continuous," with edges of buckets in contact; "Lip Type," with edges of buckets overlapping—material being spouted into conveyor in constant stream without spill or scatter.

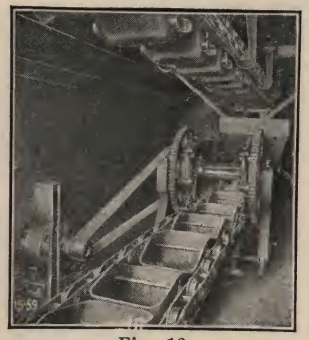


Fig. 16
INSTALLATION OF PIVOTED BUCKET CONVEYOR

Buckets are suspended on pivots so that gravity keeps them upright whether track be horizontal, vertical or inclined. Conveyor driven by pawls which run smoothly on driving pins on chains. Whole conveyor designed for thorough lubrication of all bearings.

Capacity secured not by speed but by enlarged bucket. Operation entirely automatic. All parts interchangeable. Conveyor will operate on 5 to 10 h. p.

Special automatic machinery is designed for filling each "Standard" type bucket with definite quantity of material. Several fillers can be arranged for measuring and mixing different materials.

HUNT OVERHEAD WEIGHING LARRIES

Built to meet existing conditions with one-way or bifurcated chutes to serve a single or double line of stoker hoppers. Accurate records of coal consumption registered on cards. Manually or electrically operated either from boiler-room floor or cab. Capacities, ½ ton and up.

Fig. 15. OVERHEAD WEIGHING LARRY

Fig. 23

MacDONALD-MANN QUENCHING CHUTES

MacDonald-Mann quenching chutes are now installed in numerous gas plants and are highly recommended. These chutes are water-sealed and prevent leakage of air into the chutes, and liability of combustion is eliminated. A better grade of coke is produced, less water is used for quenching, and the charging-room and basement are free from steam and gases.

HUNT CUT-OFF VALVES OR GATES

For controlling flow of coal, sand, broken stone, etc., from storage bins to mechanical stokers, mixers or cars. Installed at side or bottom of bins, or at end of spout. Hand-operated by single lever, but power can be applied to larger sizes. Have no sliding parts or gears, but jaws

Fig. 20.
LOW BODY DUPLEX VALVE

rotate on centers, cutting through material without jamming. Normal tendency of valve is to close automatically by gravity. Almost every requirement may be met with Standard types or modifications.

Fig. 20 shows a low body duplex valve with outside flanges particularly suitable for ash hoppers. If the conditions are unfavorable for the operation of any other type of cut-off valve, these duplex valves will be successful. They are heavily built and are not quickly burned out.

Fig. 22. VALVES AND CHUTES

These valves are also used for handling coal and broken stone and are operating satisfactorily where other types have failed.

STEEL COAL TUBS

Fig. 24. HUNT STEEL COAL TUBS

For unloading coal, stone, ore, etc., from canal boats, and in similar uses. Approximately spherical in shape, fitted with side or back lever catch. Strongly made of heavy steel plate, top-heavy when loaded; bottom-heavy when empty; and low in height—easily loaded and dumped. Capacities, 1/6 to 1 ton of coal.

ELECTRIC LOCOMOTIVES FOR INDUSTRIAL AND MINE SERVICE

Narrow gage electric locomotives in connection with industrial railways further reduce cost of handling material. Designed to take full load around 12-ft. radius curves as easily as on straight track. Various types of locomotives are made to pull loads up to 50 tons.

Fig. 11
STANDARD ELECTRIC LOCOMOTIVE

Standard machine as shown (Fig. 11) is built for any track gage from 18 to 36 in. Minimum curve radius, 10 ft. Rated draw bar pull 800 lbs., at 4 miles per hour; steel wheels slip at 1,600 lbs. starting pull. The operator is protected by sliding top on cab. Over all height from top of rail to top of cab, 52 in. Battery capacity ample for full day's work. Battery box easily removable for extra set of cells for 24 hours' service.

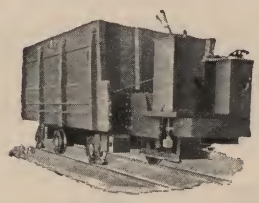


Fig. 12
MOTOR DRIVEN SELF-DUMPING CAR

Locomotives can be equipped with storage battery for motive power, or current can be taken from overhead trolley or from third rails. Motors and gears are housed to protect them from injury and dust. Speed, variable, from 1 to 10 miles.

Also load carrying motor cars (Fig. 12), 1-ton to 10-ton capacities for overhead trolley or third rail systems.

HUNT CABLE RAILWAYS

Adapted for handling coal and for carrying heavy material from point to point. Used extensively in conveying coal from barge to storage bins. Standard gage, 21½ in.; curve radius, 12 to 30 ft.

HUNT AUTOMATIC RAILWAY

Designed primarily for transporting coal, sand, rock, cement and similar bulk materials from railway cars or vessels to storage bins where run does not exceed 600 ft. Operation is entirely automatic. Time consumed for round trip of 300 ft., dumping its load and returning, is about 50 seconds. Requires service of only one man—the craneman.

In operation, loaded car is started down an inclined track, and a few feet ahead of discharging point picks up a cross bar which is attached to a cable leading to a weight box. This raises weight box, and when load is discharged from car the reaction due to falling weight returns empty car to loading point.

Fig. 13

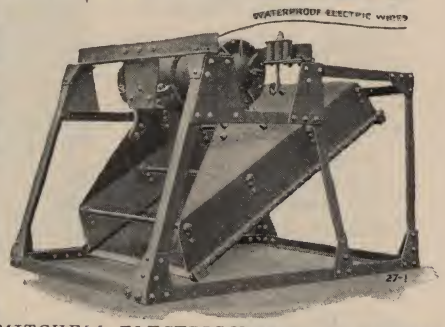
Two sizes of cars are manufactured: 1-ton and 2-ton capacity. Made of wood, lined with sheet steel.

MITCHELL ELECTRIC VIBRATING SCREENS

The Mitchell Screen is especially adaptable to the screening of coal and coke. In the re-screening of coke, the terrific vibrations, occurring 3,600 times a minute, remove all breeze at the lowest cost per ton.

These terrific, sustained vibrations, occurring at the rate of 60 times a second—the result of a circular motion which throws the cloth up into the coke to be screened, and a side-sifting motion, similar to the old-fashioned hand shaking screen, acting in unison—violently agitate every portion of the screen and preclude the possibility of any dead areas on the surface.

It screens wet material as well as dry, coarse as well as fine, and is readily adaptable to any standard type feeding device. It requires minimum floor space and head room. It is self-contained, dust and water proof. Requires less than ¾ H. P. per standard screen.



MITCHELL ELECTRIC VIBRATING SCREEN

Where accurate sizing is desired we recommend our perforated metal screen plates. Our "Brighton Cloth" for screen covering is a specialty with us.

HUNT SKIP HOISTS

Consists of load-carrying bucket, wire hoisting rope, head and leading sheaves, electric single drum hoisting engine with motor, traveling cam control and electrically operated brake, bucket guides, loading pit valve or loading chute, control panel and push button station for operating machine.

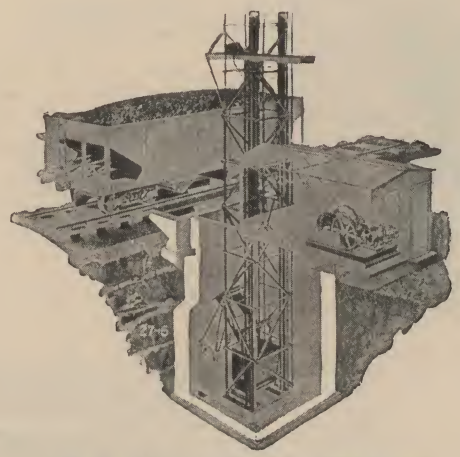


Fig. 14. SKIP HOIST IN OPERATION

Single bucket skip is counter-weighted and guides constructed for properly guiding counter-weight and bucket. Electric skips with drum type controller and steam hoist friction operated skips of high speed can be furnished if desired. Skip hoists can be operated equally well vertical or inclined. Capacities from 25 to 300 tons per hour.

"STEVEDORE" TRANSMISSION AND HOISTING ROPE

This rope is made of selected manila fiber treated with a plumbago and tallow lubricant, to reduce wear. With our "Stevedore" transmission rope we supply the Hunt coupling for controlling the stretch of ropes and eliminating splicing. "Stevedore" hoisting rope is designed for heavy hoisting purposes and is made cable-laid for well drilling.

THE SOUTHERN COAL & COKE CO., INC.

KENTUCKY AND TENNESSEE

HIGH GRADE COALS

723 DIXIE TERMINAL
CINCINNATI, O.

2235 DIME BANK BLDG.
DETROIT, MICH.

HOLSTON BANK BLDG.
KNOXVILLE, TENN.

1510 STRAUS BLDG.
CHICAGO, ILL.

1708 CANDLER BLDG.
ATLANTA, GA.

PRODUCTS

SOUTHERN STAR—GOLDEN GLOW:—

Highest grade low sulphur coking coals for by-product coke ovens; gas retorts,—especially vertical retorts,—malleable melting and other special purposes where a low ash, low sulphur coking coal is required.

HI-LO and ARCHER:—

We highly recommend these coals in the Egg size for water gas generators, in which their high quality, low ash and very hard structure make them especially desirable.. We invite any comparison with high volatile coals on efficiency bases.

DIXIE GEM:—

We offer it to you in 1¼"x2" and ⅜"x1¼" sizes. Dixie Gem in these sizes is daily serving gas producers formerly using the highest grade of Egg size coals. Dixie Gem is a non-coking, high volatile coal which stirs like gravel in a hand-poked producer. This is not a by-product coking coal, but is especially recommended to gas producer operators looking for an exceptional product.

POLICY

The Southern Coal & Coke Company has no one coal that is satisfactory for all purposes, but among our nine trade-marked, high volatile coals, there is a coal satisfactory and properly sized for your individual special purpose, provided a high volatile coal will meet that purpose.

CO-OPERATIVE SERVICE:—

We mine yearly 3,000,000 tons of coal which is serviced by an engineering department. We realize, however, that the best gas engineers are in the gas, and not the coal, business. From our twenty-five years experience producing and selling coal, we are of the opinion that the greatest mutual gain can be accomplished by our customers advising us as to their plant conditions and any unusual features thereof which may affect the selection of their fuels. Our Engineers will then gladly co-operate with you in the selection, for test, of the suitable coal.

ANALYSES:—

Ash Content of Golden Glow and Southern Star coking coals in the different sizes:

2" Nut and Slack (Maximum)	7.00%
4" Mine Run	5.00%
Mine Run	3.50%
Egg	3.00%
Lump—less than	3.00%
Sulphur—less than	1.00%

COKE CHARACTERISTICS:—

Light specific gravity, quick ignition, firm silver gray, slightly fingery.

QUIGLEY FURNACE SPECIALTIES CO., Inc.

General Office
56 W. 45th Street, NEW YORK, N. Y.
Cable Address: "QUIGLECO" New York
Representatives in more than 100 cities in the United States, Canada and at many foreign points

HYTEMPITE, a plastic refractory material scientifically compounded for laying firebrick, or to be mixed with crushed old firebrick or **GANISAND** for patching retorts and coke ovens, repairs, monolithic baffles, special shapes, etc.

GANISAND, a highly refractory granular material for making repairs and patches, baffles, rammed-in linings, special shapes, etc., when bonded with **HYTEMPITE.**

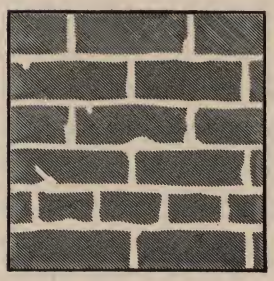
QUIGLEY REFRACTORY GUN, for repairs and construction work on furnaces, retorts, coke ovens, baffles, etc.

QUIGLEY ACID-PROOF CEMENT, a ready-to-use cement for bonding and surfacing acid resisting masonry. A mortar and protective coating. It resists strong, weak or mixed solutions of sulphuric, nitric, hydrochloric, phosphoric and other corrosive acids.

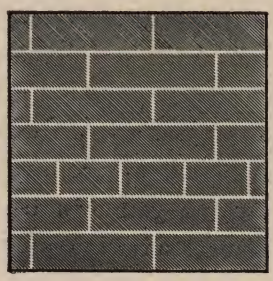
QUIGLEY TRIPLE-A PROTECTIVE COATINGS in black and colors which prevent corrosion of iron, steel, galvanized and plated surfaces, and for protecting concrete, stone, brick, cork insulation, etc., from disintegration. They are alkali and waterproof and resist the action of acids, acid fumes and vapors.

QUIGLEY SERVICE, rendered by our distributors, with warehouse stock, located in every industrial center in the United States, Canada and at many foreign points.

HOW TO LAY FIRE BRICK



The Wrong Way
89% Brick
11% Fire Clay Joint



The Right Way
97% Brick
3% Hytempite Joint

HYTEMPITE

The standard for comparison in high temperature cements. It air sets at normal temperatures and retains its strength up to temperatures at which the best fire brick loses strength and becomes soft. **HYTEMPITE** makes a joint as strong as the brick itself. **HYTEMPITE** insures a tight wall or structure which will not admit the passage of gases and will prevent air leakage.

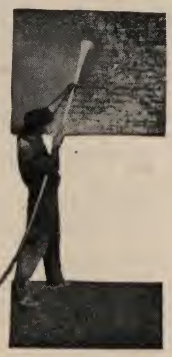
Patching Retorts with Hytempite

Repairs can be made without letting down the ovens. Broken walls can be mended while they are hot.

It withstands the cutting action of flames and protects a brick structure from the action of high velocity gases. It can be used wherever fire brick or tile is used.

Four hundred pounds of HYTEMPITE will lay 1000 brick—this factor should be considered in figuring cost of fire brick construction.

QUIGLEY REFRACTORY GUN



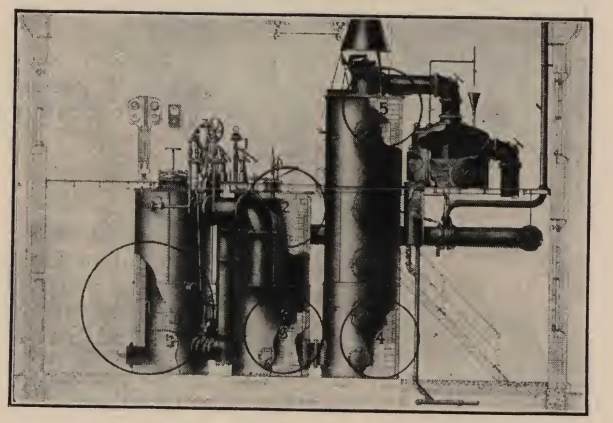
It shoots plastic refractory materials of proper consistency with high velocity to any place in wall, arch, retort, coke oven, etc. The mixture will stick to a hot or cold wall, owing to force of application, in cases where troweled or rammed-in application might fail to hold. With the Gun you can

Fill cracks or holes
Restore a burned-out wall
Fill gaps in walls or arches
Re-surface old walls
Repair leaky baffles
Build new baffles
Surface new walls

In this typical repair job (illustrated) the operator steps close to the wall to fill large cracks or holes. Then he backs away a short distance for an even distribution of the plastic material over the surface. If coating thicker than ¼ inch is needed apply in successive layers.

The Quigley Refractory Gun is portable, with a long hose attachment, so that your repair man can enter the furnace with the nozzle for large repair jobs. The gun operator fills the gun and handles the controls from the outside.

Coke oven joints are kept tight by spraying HYTEMPITE mixtures into the jamb crack with the Quigley Refractory Gun. This operation can be carried on while the ovens are hot.



In These Five Zones, Hytempite Reduces Repairs

QUIGLEY TRIPLE-A PROTECTIVE COATINGS

ANTI ACID ALKA QUA AAA (Reg. U. S. Pat. Off.)

They meet the demand for real protection under most severe conditions. They are not "just paints." They combine the three essentials for a permanent protective coating of iron, steel, galvanized and plated surfaces, concrete, stone, brick, cork insulation, etc. They are alkali-proof, waterproof, and resist the action of acids.

Colors:—There are twelve standard colors: black, maroon, green, red, fire department red, gray, buff, yellow, white, blue, dielectric black, and aluminum. Black and colors may be used direct on metal surfaces. The colors are used direct on concrete, brick, stone, cork insulation, etc.

THE ATLAS CAR & MANUFACTURING CO.

Engineers **Manufacturers**

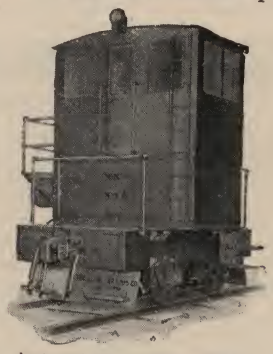
CLEVELAND, OHIO

PRODUCTS:

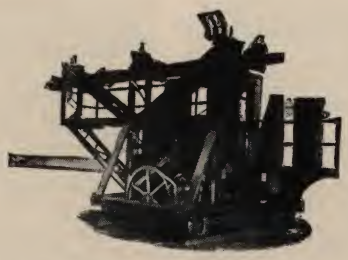
Diesel-Electric and Gas-Electric Locomotives, Storage Battery Cars, Storage Battery Locomotives, Storage Battery Locomotive Cranes, Electrically Operated Industrial Cars. Coke Pushers, Coal Charging Larries, Door Handling Machines, and Coke Quenching Cars for By-Product Coke Ovens. Ore Transfer Cars and Blast Furnace Charging Cars, Scale Cars and Weighing Cars of all kinds. All kinds of Special Industrial Cars, Track, Switches and Turntables. The Atlas Patented Scale Indicating and Recording Mechanism, Wheels, Axles, Car Parts and Trucks, Builders of Gas Producers.

We have manufactured this type of machinery since the inception of gas and by-product plants and Atlas equipment has come to be highly regarded by gas and coke plant operators.

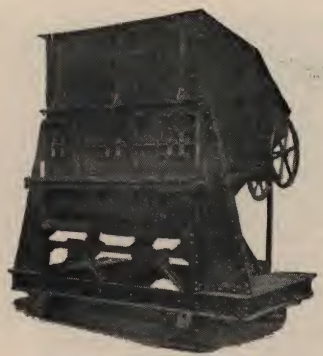
We welcome inquiries for equipment of this type, knowing that our experience in this line will assure complete satisfaction.



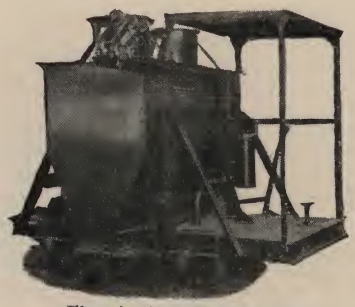
Industrial or Coke Plant Electric Locomotive



Combined Coke Pusher and Door Extractor for 2 Ton Capacity Gas Plant

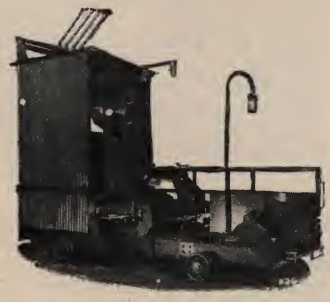


Coke Quenching Car on Gas Plant Installation

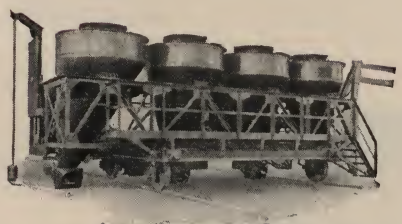


Electric Two-Hopper Coal Charging Car

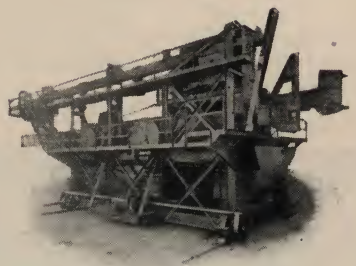
Coke Guide



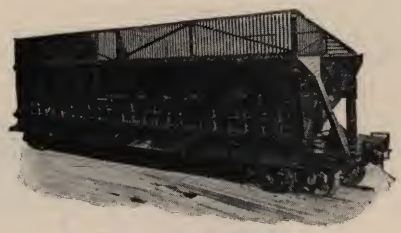
Door Extracting Machine



Electric Four Hopper Coal Larry



Combined Pusher, Leveler and Door Machine



Coke Quenching Car, furnished with or without Motor Drive

THE AMERICAN METAL HOSE CO.

WATERBURY, CONN.

Manufacturers of Flexible Metal Hose and Tubing

SALES OFFICES

New York, N. Y.—173 Lafayette St.
Pittsburgh, Pa.—1820 Oliver Bldg.
Boston, Mass.—519 Statler Building.
Chicago, Ill.—111 West Washington St.

Canadian Selling Agent: Lytle Engineering Specialties, Ltd., Montreal, Canada
Pacific Coast Agent: F. Somers Peterson Co., San Francisco, Cal.

PRODUCTS:

"American" Flexible Metal Holder Hose, Flexible Metal Steam Hose, Flexible Metal Oil Hose, Flexible Metal Gas Tubing, etc.

DESCRIPTION

"American" Flexible Metal Hose is generally made either from a galvanized steel or a high tensile strength phosphor bronze strip. It has a flexibility equal to or greater than that of rubber hose and due to the ability of these metals to resist various chemical actions which quickly deteriorate rubber or combination hose and to

Shows Construction of Style "A" Holder Hose

its strong four-wall interlocking construction, is much more lasting. "American" Flexible Metal Hose is adaptable to many kinds of work but its real value is best demonstrated in the more severe services, that is, in those duties where rubber or combination hose is short-lived and ineffective.

"AMERICAN" FLEXIBLE METAL HOLDER HOSE

is manufactured in two styles, "A" (for short lengths) and "B" (for longer lengths) and in sizes ½ in., ¾ in. and 1 in. inside diameter. Permanency and reliability, qualities which are most desirable in Holder Hose, are developed to the highest possible degree in "American" Flexible Bronze Holder Hose. Its core is a heavy, four-wall, interlocked bronze steam hose which in style "B" is covered with a strong supporting braid of phosphor bronze wires. A thick asbestos wicking is then wrapped around the inner hose to prevent heat radiation and condensation. Finally a second phosphor bronze wire braid is put on over the asbestos wicking and serves not only to hold it in place but also as a permanent weatherproof jacket. As an alternative to the outside of phosphor bronze braid, a specially treated, weatherproofed, woven cotton jacket can be supplied. This style of covering is slightly cheaper than the bronze and very nearly as efficient. "American" Holder Hose Couplings are standard iron pipe thread, heavy brass, straight female couplings threaded securely onto the hose. Long flexible metal reinforcements used in connection with these couplings distribute the strain which would otherwise occur where the hose joins the couplings.

"AMERICAN" FLEXIBLE METAL STEAM HOSE

BD15 (Unbraided) and BD20 (Braided) Bronze Steam Hose is made in sizes from 3/16 in. up to 8 in. and equipped with packed-on, heat-proof couplings having an iron pipe thread corresponding to the inside diameter of the hose. Non-corrosive, steam tight, very flexible, light and easy to handle but still strong and durable, it gives extremely efficient service when used for conveying steam even at highest pressures. It is especially serviceable when used as a flexible connection for oil skimmer work, decarbonizing on oven batteries, blowing boiler flues, and steaming out Tank Cars prior to or during unloading.

Shows Construction of Style "B" Holder Hose

"AMERICAN" FLEXIBLE METAL OIL HOSE

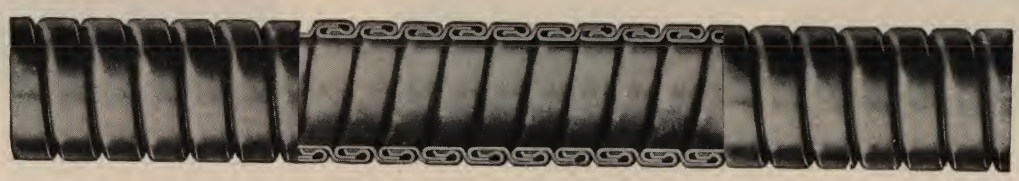
BD15 (Unbraided) and BD20 (Braided) Galvanized Steel Oil Hose is made in the same sizes as steam hose and can be furnished with either soldered-on or packed-on, heat-proof iron pipe thread couplings. It is the ideal hose for handling oils and grease. Both oil and grease, since they prevent rusting and also lubricate the joints of the hose, actually increase its life and flexibility. For unloading Tank Cars of oil, tar, asphalt, etc., and for the general handling of these same materials, it gives unexcelled service.

A TANK CAR UNLOADING HOSE ASSEMBLY

consists of a length of 2", 2½", 3" or 4" BD 15 Flexible Galvanized Steel Oil Hose with a 60° Elbow Coupling threaded specially to fit the Outlets of Tank Cars attached to one end. A straight I.P.T. Coupling corresponding to the inside diameter of the Hose, and which connects with the inlet of the storage tank, is attached to the other end. The Elbow Coupling with its special coarse thread insures a quick connection and therefore keeps the "spillage" down to the minimum. The flexibility of the complete assembly also does away with the necessity of "spotting" Tank Cars. Folders describing our Unloading Hose will be sent on request.

GENERAL

"American" Flexible Metal Hose is manufactured in many other styles and used for many other services than those already mentioned. Our technical department will be glad to send literature on or answer any questions pertaining to "American" Flexible Metal Hose.



Section of BD-15 Type of Hose Cut to Show Interlock ing Construction

MERRICK SCALE MANUFACTURING CO.

Automatic Continuous Weighing Machines

PASSAIC, N. J.

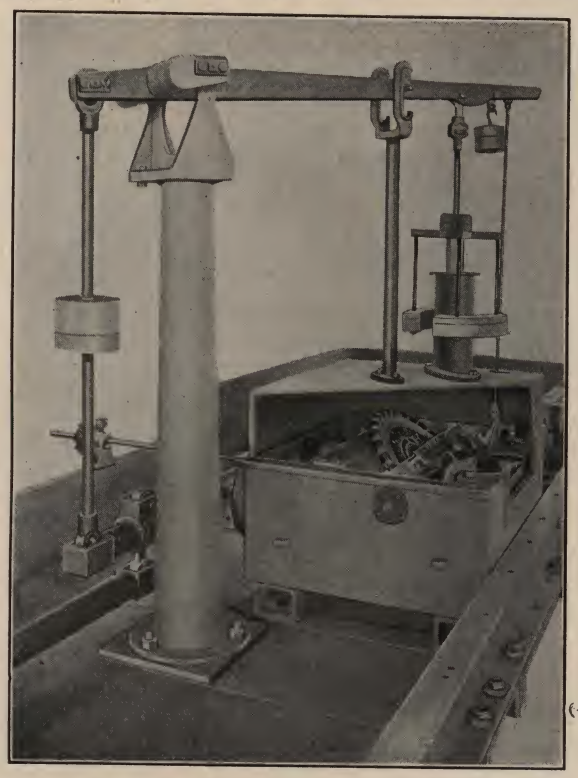
THE MERRICK CONVEYOR WEIGHTOMETER

Trademark Registered U. S. Pat. Office

The problem of weighing and conveying bulk material is one which every Gas, Power and By-Product plant has to solve. Wherever a conveyor can be used to carry material, a Weightometer installed on this conveyor will weigh on the fly—all passing material carried on the conveyor.

Docks—By-Product Coke—Power and Gas Plants weigh coal and coke in this manner for various records, checking in and billing out weights. MERRICK CONVEYOR WEIGHTOMETERS by reason of their easy installation, adjustment, mechanical simplicity and low maintenance cost, are particularly adapted for this work.

Due to the fact that seldom are any two conveyors alike in all characteristics, each MERRICK CONVEYOR WEIGHTOMETER is designed and built for the conveyor



Cut No. 4—Showing weigh beam standard, fulcrum bracket with weigh beam; also integrator box with part of the cover cut away to show details of construction.

on which it must operate. It is adaptable for use on belt, bucket or pan conveyors. The MERRICK WEIGHTOMETER can be fitted for all inclinations, sizes, types, capacities, speeds, etc., compatible with conveyor practice.

Just a word about the simple operation of Merrick Scales—Several carrying idlers, removed from the conveyor stringers are bolted on a frame of angles hung from the levers of the Weightometer, thus suspending from twelve to twenty feet of carrying belt, while the drive for the integrating mechanism is taken from a pulley snubbed against the return belt, through sprockets and chain. The accompanying photo of the interior with the outside casing sheets removed and integrator exposed will show how the load on conveyor is counterbalanced by an iron float in a pot of mercury so that the beam deflects to a height in proportion to this load.

The slender rod from the end of beam to the small bracket on the frame holding the disc tilts this disc from

Installation of a Merrick Weightometer weighing coal in a prominent gas plant.

its vertical balance position to an amount proportional to load. Thus with the narrow endless belt shown traveling continuously in a horizontal circuit (impelled by the snub pulley mentioned before) and pressing against the disc, the latter is forced to rotate on its own axis and register on a counter the weight carried by the conveyor belt. This operation is purely mechanical and any intelligent mechanic can readily understand the functions of each part. A very important consideration when purchasing a machine of this kind.

The MERRICK CONVEYOR WEIGHTOMETER weighs and records the weight of any material while in transit over the conveyor, without interrupting the flow, and needs no attendant or weighman.

The scales are guaranteed and have been proven accurate within 99 per cent.

Our engineers are always ready at any time to discuss your problems with you and to assist you in any way in solving your weighing problems.

THE ANTHONY COMPANY

Liquid Fuel Engineers
138 West Avenue
LONG ISLAND CITY, N. Y.

PRODUCTS

ANTHONY NEBULYTE SYSTEM for boilers and for furnaces; ANTHONY NEBULYTE OIL BURNERS, GAS BURNERS, TAR BURNERS, COMBINATION OIL, TAR and GAS BURNERS, TORCHES.

ANTHONY NEBULYTE OIL, TAR and GAS BURNING EQUIPMENT for all industrial heating processes.

ANTHONY NEBULYTE OIL and TAR SPRAYS for gas plants and SPRAYS for all liquids.

ANTHONY OIL, TAR and GAS FORGES, CRUCIBLE FURNACES and HEAT TREATING FURNACES.

ANTHONY SINGLE and DUPLEX STAINERS; STEAM and ELECTRIC FUEL OIL HEATERS; TANK SUCTION UNITS; HAND and AUTOMATIC CONTROLS.

ENGINEERING SERVICE

Anthony engineers are prepared to discuss all heating problems and design special oil, tar or gas fired apparatus for specific needs. Having designed a great variety of successful industrial heat treating systems, they have wide experience in this field to place at a client's disposal. THE ANTHONY COMPANY, since its organization, has dealt with every application as an individual combustion problem, appreciating as no others have, its many sensitive and variable conditions, and accurately meeting these by correctly utilizing essential principles.

They are pioneers in the development of mechanical nebulization as applied to the combustion of liquid fuel, as well as in the application of those combustion principles which effect the accurate control of heat quality. Employment of their services leads to conservation of fuel, speeding up of production and better quality of output, as 5,000 clients will testify.

More than twenty years of record-smashing success.

ANTHONY NEBULYTE SYSTEMS

For Boilers—A mechanical nebulizing system which actually attains the perfection of radiant gas firing and normally produces 80% to 86% evaporating efficiency.

For Furnaces—A mechanical nebulizing system of gas firing with oil fuel, effecting an instantaneous conversion of liquid to gas by correct combination of essential elements.

ANTHONY NEBULYTE BURNERS and TORCHES

The first free-acting nebulizers applied to industrial furnaces. Simple. Powerful. Sturdy.

Applicable whether forges, furnaces, stills, dryers, boilers, kilns or other apparatus require heat. Low and high pressure designs to suit every requirement.

70,000 installations of proven superiority.

ANTHONY FUEL OIL HEATERS

Fuel oil heaters are essential in every oil burning system using oils of relatively heavy gravity.

Anthony heaters are supplied to give the required temperature to the particular grade of oil specified. Furnished complete with safety relief valve, thermometer, and, where desired, automatic temperature control.

ANTHONY STRAINERS

Both single and duplex types. In the duplex strainers, either side can be cut out by a single lever movement. They need not be taken apart for cleaning. They are easily applied to any pipe line. The cleaning operation is made so simple that there is no excuse for strainers ever becoming foul.

ANTHONY FUEL EQUIPMENT

The continuous and successful operation of any fuel system depends upon the use of correct equipment, installed and adjusted in accordance with established facts. Special equipment for every part of liquid and gas fuel systems supplied, based upon the experience of many years. Tanks, pumps, blowers, valves, gauges, meters and all necessary appurtenances.

ANTHONY FORGES AND FURNACES

These include rivet forges, crucible furnaces and a general line of heat treating furnaces built to take advantage of the superior operating characteristics of Nebulyte Burners. Simple, compact, sturdy, non-oxidizing. Low operating cost. Portable and stationary.

ANTHONY NEBULYTE SPRAYS for GAS PLANTS

These are mechanical nebulizers of oil or tar—scientific distributors of spray. They are the means of distributing oil or tar in correct quantity over selected parts of a gas machine or generator as the operator may require.

Anthony Nebulyte Spray

Note the mist of liquid

Anthony Nebulyte Sprays are milestones in the progress of gas manufacture. All sprays are built to meet the scientific requirements of each installation. They are adapted to suit any prevailing conditions.

These sprays are of simple design and sturdy construction. They give perfect *nebulization,* positive control and correct distribution.

ANTHONY NEBULYTE SPRAYS for all LIQUIDS

Sprays supplied of definite capacity and throw which can be utilized for many purposes, such as cooling, aerating, atomizing, gasifying, mixing, absorbing gases and vapors, and for all purposes where it is desired to distribute a liquid in finely divided form over a large area, or through a large volume. Scientific distributors. Free acting. Conical and flat types.

THE ALPHA-LUX COMPANY

Incorporated

192 FRONT STREET - NEW YORK CITY

Shipping Points—New York, Philadelphia, Boston, Baltimore, Galveston, Jacksonville, New Orleans, Los Angeles, San Francisco, Portland, Ore.

PRODUCT: Gas Purifying Material

Also—Lux Recording Gauge—for Specific Gravity of Gas. Dr. Ott-Lux-Gas Tester—for instantaneous indication of Gravity and Heating Value. Luxit—the Fireproof Concrete, eliminating Fire Bricks. Prof. Dr. Strache-Gas Leak Finder "Rapid"—Strache Portable Calorimeter.

Lux Material

Lux Material has a greater absorbing capacity for sulphur than any other, and therefore more gas per bushel can be purified with it. As soon as put in the boxes acts with full vigor. In contrast with all other material it works equally well in the first application.

Lux Material can be traversed by the gas at a higher velocity (a great advantage in plants working at times beyond the capacity of their purifiers). The capacity may be increased 50 to 100% by using "LUX." It will purify the gas, no matter how low in temperature it enters the boxes; and will eliminate the trouble of free iron deposits at the burners of the consumers, so often found to be the case when using artificial oxide for purifying gas.

Lux Material has a lower specific weight than any other; the weight per bushel is less, and less material by weight will be required to fill your purifying boxes; you get a much larger purifying surface, another important point figuring cost of sponge. Contains no dead weight of earth or fibre like natural ore, nor unrusted iron like artificial sponge. *EVERY PARTICLE OF "LUX" PURIFIES.*

Lux Material remains longer in the boxes; requires fewer changes before it is fully saturated; which means smooth running of the works and saving in labor and wages. It will revivify quicker than any other and will purify gas better and cheaper per thousand than any other material.

Lux Material contains the highest percentage of Fe_2O_3 in the proper shape, namely, as Ferric Hydroxide. On dry basis Lux shows 52 to 59 per cent of Ferric Hydroxide. Its lime content is very low, no more than 3 to 3½ per cent.

Lux Material **never varies. It has been of a uniform quality for half a century.**

———::———

Our Sponge plant, modernly equipped for mixing Lux, enables the small and medium size plant to use exactly the same oxide which is used by the majority of the largest plants in the United States.

Lux-Sponge

THE PERFECT READY MIXED OXIDE

For low time contact, low temperature or any severe purifying service. Will purify more gas, revivify quicker and yield less back pressure.

Gas Purifying Materials Co., Inc.

Branch Yard
Providence, R.I.

OXIDE
GPM

Foot of Halsey Street
Long Island City, N.Y.

Southern Representative, Mulcare Engineering Co. **100 Park Place, New York, N. Y.**

IRON BORING OXIDE

The Most Purification for the Dollar

Removes the largest amount of H_2S at the lowest cost.
Noted for its long life without back pressure difficulties.
Remains active while in use—revivifies completely and quickly.
Large stocks always available at both yards.
Shipments by rail or water.
A carefully made AMERICAN PRODUCT guaranteed to give satisfaction.

Over 126 Billion cu. ft. of gas purified in 1928 with G.P.M. oxide

Visit these plants and see the care used in manufacturing G.P.M. oxide.

LONG ISLAND CITY YARD

PROVIDENCE, R. I., YARD

TAYLOR INSTRUMENT COMPANIES

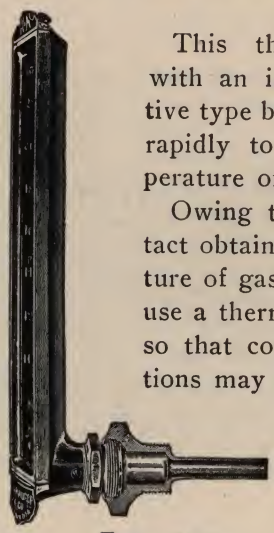
ROCHESTER, N. Y., U. S. A.
Canadian Plant, Tycos Building, Toronto, Canada

NEW YORK CHICAGO BOSTON PHILADELPHIA PITTSBURGH CLEVELAND
SEATTLE LOS ANGELES INDIANAPOLIS SAN FRANCISCO
ST. LOUIS CINCINNATI TULSA DETROIT ATLANTA MINNEAPOLIS
Manufacturers and Distributors in Great BRITAIN—SHORT & MASON, Ltd., LONDON

PRODUCTS:

Tycos Industrial Thermometers for Gas Mains, Station Meters, Condensers, By-Product Plants.
Tycos Regulators for Ammonia Stills, Condensers, etc.
Tycos Recording Pressure Gauges for purifiers, stills, etc.
Tycos Recording Thermometers for coolers, exhausters, ammonia concentrators, holders, gas lines, benzol stills, station meters.
Tycos Engraved Thermometers for calorimeters and meters.
Tycos Hydrometers for Ammonia and Oil testing.
Tycos Pyrometers for Combustion Chambers, Retort Benches, etc.
Tycos Gas Compressors.
Tycos Calorimeter Thermometers.

TYCOS GAS MAIN THERMOMETERS



Tycos Angle Thermometer

This thermometer is provided with an insulated stem and sensitive type bulb so that it will respond rapidly to slight changes in temperature of the heat medium.

Owing to the poor thermal contact obtained in taking the temperature of gas or air, it is necessary to use a thermometer of such a design so that correct temperature indications may be secured.

TYCOS RECORDING THERMOMETERS

The *Tycos* Recording Thermometer is for use on Station meters, inlet and outlet of condensers, oil lines, ammonia stills, feed water lines, flue gases, etc., where a continuous record of the heat changes is desired.

Tycos Recording Thermometers are operated by the expansion of mercury, vapor tension or gas contained in a powerful tube system of practical construction which insures great sensitiveness, yet lacking entirely in delicate features.

The graduations of the chart are uniform throughout the entire range and the indications of the instrument are of a high degree of accuracy, and permanent reliability.

Tycos Recording Thermometers

TYCOS PYROMETERS FOR GAS PLANTS

Tycos High Resistance Wall Type Indicator (Pyrometer)

Base Metal Pyrometers are used on low temperature gases in the boiler breeching, the chimney of the coal gas benches, and the individual bench flues, to regulate each one separately, in the stack of coke ovens, and in the flue of waste heat boilers and on water gas machines.

Rare Metal Pyrometers are high temperature instruments used to indicate high temperatures in boilers, coal gas benches, coke ovens, water gas machines and blue gas machines.

Radiation Pyrometers are used to look into a fire box or complexion flue and read the temperature by means of the radiant heat absorbed by the instrument. These instruments are easily and quickly read, thus giving valuable data on what takes place in the unit, so that more efficient results can be maintained.

Indicating Pyrometers are used with the Radiation Pyrometer and either the Base or Rare

Tycos High Resistance Metal Case Recording Pyrometer

Metal Pyrometers for any of the purposes mentioned above. By means of multiple equipment a number of temperatures can be read in the central office of the gas works, which enables the superintendent to check up operation very closely.

Recording Pyrometers not only indicate but record the temperatures and are a valuable guide to gas plant operation. These are made for all practical conditions and are especially valuable on coke oven generators and water gas sets.

All instruments can be supplied automatically compensated for cold junction.

TYCOS THERMOPYRE

The *Tycos* Thermopyre is a self-contained high-temperature portable pyrometer consisting of a thirty-nine inch calorized "Tycalloy"-stem thermocouple, or fire-end, combined with a compact, rugged millivoltmeter movement of good grade in a single unit and having a scale range of 2200°

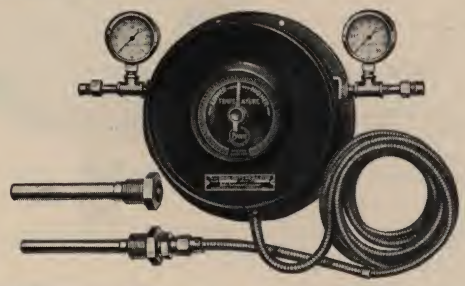
Tycos Thermopyres meet the demand for a low-priced instrument, for intermittent rough checking purposes above the range of mercury thermometers (950° F.). They are not precision instruments in the strict sense of the word and are not sold as such, but their accuracy is as close as 20° F., or one scale division on the 2200° F. range, which is sufficient for many industrial checking operations where relative accuracy only is required. The uses for such an instrument, therefore, are many and varied.

TYCOS INDEX THERMOMETERS

Tycos Index Thermometers are especially adapted to applications where, on account of inaccessibility or inconvenience of observation, a mercury column thermometer is impracticable. Frequently, on industrial installations, thermometers are located in out-of-the-way places, where the light is poor, and consequently observations are not taken as regularly as they should be. *Tycos* Index Thermometers eliminate this condition, since the flexible connecting tubing can be made any length required up to 25 feet with mercury-actuated systems, and 75 feet with vapor-tension and gas-actuated systems, thus permitting the case to be set up in a position where readings can be conveniently taken.

TYCOS CONDENSER, SCRUBBER AND STILL TEMPERATURE REGULATOR

In manufacturing gas and refining its by-products it is very important that an instrument be used to control the gas and absorbent temperatures within close limits.



Singl-Duty—This type of capillary regulator has a single expansion chamber, and controls the steam supply for such an apparatus as on Volatile Stills, Condensers, Ammonia Liquor Concentrator, Cooling Coils, Hot Water Tanks or any apparatus heated from one source.

METER PROVER THERMOMETER

To insure efficient work in proving House Meters, the thermometer should not only be accurate but adapted for the work, in order to make the indications easily observable. Both these features are incorporated in the *Tycos* Meter Prover Thermometers as well as practical and substantial construction of the protecting casing, which for the water thermometer consists in a cylindrical galvanized case fitted with rubber buffers, while the air thermometer has a polished face V-shaped nickel case with brackets for securing to wall and insuring circulation of air around the bulb.

CONSOLIDATED ASHCROFT HANCOCK CO., INC.

Subsidiary of Manning, Maxwell and Moore, Inc.

Makers of

AMERICAN INDUSTRIAL INSTRUMENTS

100 East 42nd Street **Since 1851** **New York City**

Branches in Principal Cities

PRODUCTS

Manufacturers of INDICATING and RECORDING GAUGES; GAUGE TESTERS; "U" GAUGES; DRAFT GAUGES; INDICATING and RECORDING THERMOMETERS; TACHOMETERS; DIAL THERMOMETERS; PRESSURE AND TEMPERATURE CONTROLLERS; ELECTRIC TEMPERATURE CONTROLLERS; POP SAFETY AND WATER RELIEF VALVES; STEAM TRAPS; ENGINE INDICATORS; COUNTERS; ABSOLUTE PRESSURE GAUGES.

Also manufacturers of LOCOMOTIVE and ENGINE ROOM CLOCKS; BAROMETERS; MERCURY COLUMN GAUGES; STEAM WHISTLES; HYDRAULAGRAPHS; GAUGE BOARDS.

AMERICAN GAS MAKER'S GAUGE

The Standard Gauge of Gas Industry for Blast Mains, Generators, Carburetors, Wash Boxes, Superheaters, Condensers, etc. The complete diaphragm is inside the case where it is held between two curved plates which limit its motion, and in case of excess pressure, the diaphragm cannot stretch. There is perfect protection against loss of calibration through accidental overload. Also, in case of excess pressure due to local explosions, this gauge will not be put out of commission. Made in 4½-inch, 6-inch and 10-inch dial sizes. Standard Pressures 0-20, 0-30, 0-60, 0-100, 0-150 inches of water.

Write for Catalog P-28.

AMERICAN QUALITY GAUGES

American Quality Gauges are made in all sizes from 2½-inch to 12-inch, for pressures from 10 lbs. to 30,000 lbs., and also for vacuum. Cases are cast iron or cast brass. The movements are Heavy Duty and all bearings are Monel Metal.

Write for Catalog No. A-28.

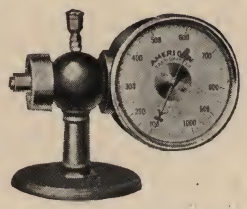
For Mercury Pressure and Vacuum Gauges, "U" Gauges, Draft Gauges and Mercurial Barometers write for Catalog No. B-28.

AMERICAN TACHOMETERS

American Tachometers are made in hand and stationary types for measuring speeds of shaftings, machines, motors, turbines, etc., directly in revolutions per minute.

Stationary type is for permanent connection, both indicating and recording, for all applications. Hand tachometer weighs only 13 oz. for speeds from 30 to 12,000 R.P.M.

Write for Catalog No. J-28.



AMERICAN RECORDING GAUGES

American Recording Gauges are made for all pressures from 15 inches of water to 10,000 lbs. and for vacuum. They are made in one size only to accommodate a 10-inch chart, having an effective scale width of 3⅝ inches. The case is Die Cast with a dull black hard-rubber finish and with either bottom or back connections. The pen-arm is made of non-corrosive Monel Metal and is of the inverted type. Operating instructions are lithographed on the chart plate so that they cannot be lost.

Especially designed Seth Thomas clocks are used, and all customary time periods can be furnished.

American Recording Gauges are equipped with the Time Punch which virtually makes each instrument a time clock, since a hole is punched in the chart whenever a reading is taken.

Write for Catalog E-28.

AMERICAN RECORDING THERMOMETERS

American Recording Thermometers are made for recording all temperatures from minus 40 to plus 1,000° F. or equivalent C., and with very flexible connecting tubing up to 200 feet. Made in one size only to accommodate 10-inch chart, with any effective scale width of 3⅝-inches.

The case is the same as for the American Recording Gauge, so that all instruments are uniform in appearance when mounted on Gauge Boards. American Indicating Gauges and Dial Thermometers are also furnished in same case.

Write for Catalog H-28.

AMERICAN INDICATING THERMOMETERS

American Glass Indicating Thermometers are made in all sizes and types for every industrial application. There are standardized types for certain specific uses, and prices range from the cheap pocket test thermometer to the most expensive industrial type with the 12-inch scale. Scale ranges are standardized and run from minus 40 to plus 1,000° F.

Write for Catalog No. F-28.

AMERICAN POP SAFETY AND WATER RELIEF VALVES

Safety Valves of brass and iron for any set pressure up to 300 lbs., and of cast steel with outside spring up to 400 lbs. Relief Valves of bronze and iron for pressures up to 10,000 lbs.

Write for Catalogs U-28 and V-28.

AMERICAN AUTOMATIC CONTROLLERS

A complete line of American Controllers for automatically controlling pressure, vacuum, temperature, condensation, humidity liquid levels, timing of processes, control of dampers, etc.

Write for Catalog R-28.

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PRODUCTS:

Boards, Gauge; Clocks; Gauges, Airplane; Gauges, Indicating, Liquid Level; Gauges, Indicating Pressure; Gauges, Indicating Vacuum; Gauges, Recording Liquid Level; Gauges, Recording Pressure; Gauges, Recording Vacuum; Indicators, Air Speed; Meters, Orifice Gas and Liquid Flow, Steam Flow; Planimeters, Radial; Psychrometers, Recording; Recorders, CO_2, for Flue Gas Analysis; Recorders, Differential Pressure; Temperature Controllers, Automatic; Humidity Controllers, Automatic; Thermometers, Airplane; Thermometers, Indicating; Thermometers, Recording; Tachometers; Tachographs.

RECORDING GAUGES

For Pressure and Vacuum

Both Stationary and Portable Types. Ranges from full vacuum to 20,000 lbs. per sq. in. Can be supplied in any unit of measurement: inches water, ounces, pounds, feet, metric units, etc. For steam, gas, water, oil, ammonia—anything under vacuum or pressure. *Write for Bulletin GA-98-3.*

INDICATING GAUGES

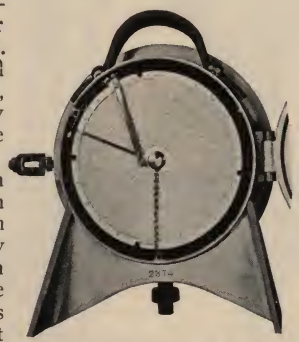
For Low Pressure and Vacuum

Are of all-metal construction; use no liquids, and have no delicate parts. They are ideal for test work. The pointer is positive and accurate.

Each instrument furnished with a high-grade stop-and-waste cock.

Lowest total range for which instrument can be calibrated is 0 to 2" water pressure or vacuum which may be distributed either side of gauge pressure. Can be supplied in 6", 8", 10" and 12" sizes. Other Standard Indicating Gauges furnished. Ranges from full vacuum to 20,000 lbs. per sq. in. *Write for Bulletin GA-136-2.*

PORTABLE RECORDING GAUGE FOR GAS LINE SERVICE

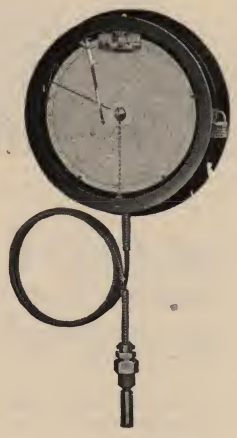


Used extensively to check gas line pressures and fluctuations. Furnished with either wood or aluminum cases. The aluminum case illustrated is of latest design. It is light, durable, handy, and absolutely moisture and dust proof. The door is also all aluminum.

Each gauge is supplied with a 36" flexible connection with standard pipe thread. It can be set anywhere. Accuracy is guaranteed within less than one per cent. of total scale range. One gas company has over 100 of these in constant use. *Write for Bulletin GA-136-2.*

INDICATING AND RECORDING THERMOMETERS

Indicating Dial Type



Greatly superior to the glass bulb mercurial thermometer. Bulbs made of metal, and no mercury used. Clear open scale permits easy and accurate readings. Two sizes, 5", 8". From —25° to +1000° Fahrenheit or corresponding ranges in Centigrade or Reaumur.

Recording

Used everywhere to provide a check on important operations. Accurate register of temperature guaranteed. No multiplying devices used. Special lead and acid-resisting bulbs made for various industries. Three sizes, 8", 10", 12". From —60° to +1000° Fahrenheit, or corresponding ranges in Centigrade or Reaumur.

For use on Stills, Condensers, Superheaters, Agitators, Coolers, Exhausters, Concentrators, Scrubbers, Purifiers, Station Meters, and anywhere else where a knowledge of temperature is vital.

Ask for Thermometer Bulletin GA. Specify type and range.

AUTOMATIC TEMPERATURE RECORDER-CONTROLLERS

A design successfully combining the functions of two instruments. The use of one bulb to actuate both the recorder and the controller element gives an accurate record of the controller element operation.

Made to same specifications as recording thermometers, but in the 10 inch size only. Air-operated, sensitive, accurate, dependable. Valves designed to operate either pressure or vacuum. An improved form of rubber diaphragm motor is employed. Duplex, time-temperature and non-recording controllers can be furnished.

All Foxboro Controllers will operate valves from ¼" to 12" and on temperatures from —25° to +1000° Fahr.

For use on Ammonia Stills, Condensers, etc., where control of gas, temperature or pressure is required.

Ask for Bulletin GA-112-2.

PRINCO

PRECISION THERMOMETER & INSTRUMENT CO.

Main Office and Factory
1434 Brandywine Street, Philadelphia, Pa.

PRINCO

HIGH GRADE SCIENTIFIC INSTRUMENTS FOR THE GAS INDUSTRY

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"PRINCO" STANDARD THERMOMETERS

PRECISION ENGINEER'S TYPE
SEPARABLE SOCKET THERMOMETERS

THERMOMETERS PRECISION Engineer's Type.

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THERMOMETERS To A. S. T. M. Specifications.

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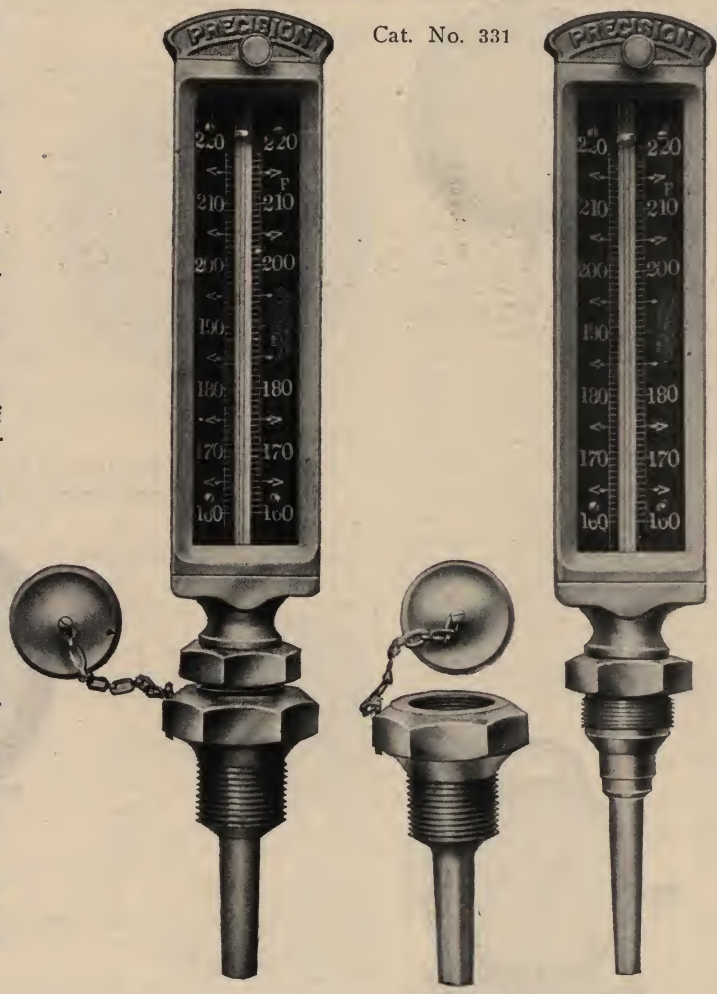

Complete With Socket | Socket Only | Socket Detached

THERMOMETERS For Turbine Jackets.

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THERMOMETERS For Feed Water.

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THERMOMETERS For Annealing Ovens.

THERMOMETERS For Weather Observations.

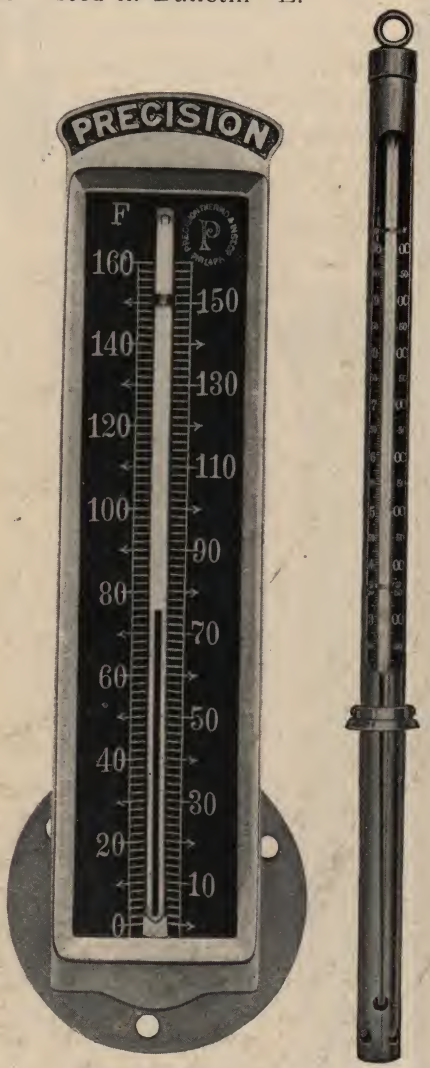
THERMOMETERS For Stacks.

Thermometers for Every Purpose for Which a Thermometer Can Be Used.

PRECISION ENGINEER'S TYPE THERMOMETERS are built in three sizes, with 7-inch, 9-inch and 12-inch Scales, are equipped with either Plain (fixed) Connections, Union Connections or Separable Socket Connections, and are supplied in a great variety of forms and modifications, making their adaptability extremely elastic. They have been passing the rigid inspection tests of the Bureau of Engineering of the United States Navy for fifteen years. These Instruments are fully described, illustrated and listed in our Bulletin "E," which will be mailed upon request. Catalogue No. 331, illustrated on the opposite page, is a Seven-Inch Straight Form Thermometer with Separable Socket Connection and is one of about four hundred and fifty different modifications of this type of Thermometer listed in Bulletin "E."

Cat. No. 318

Figures 311 and 313 illustrate two types of Thermometers with Wall Connections which can be supplied with any possible scale range from that required for a Refrigerator to that required for a Japanning Oven.



Cat. No. 313

Cat. No. 381

Figure 381 illustrates a Standard Type of Gas Oven Thermometer with which the Industrial Department of every Gas Company is familiar.

Figure 318 illustrates a simple and practical type of Thermometer for use in the Bake Oven of the Home Gas Range. Many other types are listed in Bulletin "E."

Laboratory Thermometers, Calorimeter Thermometers, Armored Thermometers, Standardized Thermometers with Bureau of Standards Certificates, and many other similar Instruments are listed in Bulletin "C," which will be mailed upon request.

PRINCO Hydrometers for Laboratory and Plant listed in Bulletin "C."

PRINCO Standard Hygrometers listed in Bulletin "C."

Cat. No. 311

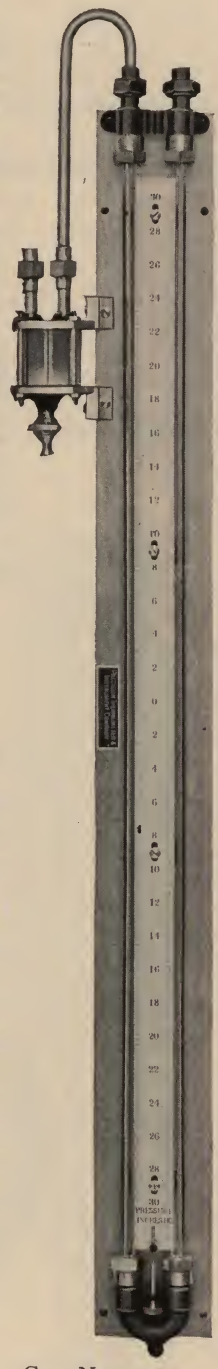
PRINCO Standard Mercurial Barometers have a world-wide reputation for reliability and accuracy. Our production of a high grade Barometer of this type that can be shipped with safety is recognized as an achievement in Instrument Making. PRINCO Barometers have been successfully shipped all over the world for the last twelve years. Indispensable in the Laboratory and Plant. Fully described and listed in Bulletin "E."

Cat. No. 399

Cat. 453-456

PRINCO Full Column Mercurial Vacuum Gauges, complete with condensation trap, are supplied in three different styles, and are in use in many Public Service Corporation Power Plants on shore and on many Shipping Board Vessels afloat. Graduated in inches and tenths, or in millimeters, with improved zero-adjustment and removable reservoir. Installed and filled with facility. Fully described and listed in Bulletin "E."

PRINCO Water Gauge, of the "U" Type illustrated by Figure No. 408 is supplied in any size from 6 to 72 inches. This Gauge is supplied with a trap, or catchall, and is provided with metal mountings throughout. The Gauge Glasses are mounted in stuffing boxes and may be removed with facility by loosening the glands when replacement becomes necessary. Also supplied with the fittings mounted on Hardwood panel instead of metal. Bulletin "E."



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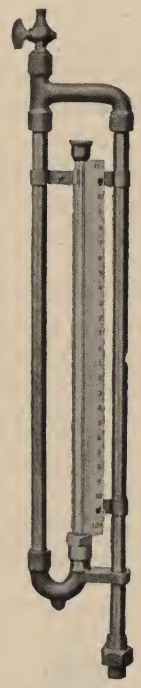


The PARKER PATENT WATER GAUGE is the recent invention of Mr. A. T. Parker, a practical gas-works engineer of many years' experience. Mr. Parker was unable to buy a water gauge that he considered satisfactory for plant use. They were either too fragile, or too clumsy or too inaccurate, or had to be returned to the factory for repairs when damaged. The Parker Gauge is not easily broken, and can be repaired installed when it is. It is all metal excepting the one glass observation tube, which is a plain standard gauge-glass. Approved by the Engineers of the U. G. I. Prices on application.

INCORPORATED IN 1910—FIFTEEN YEARSOF CONTINUOUS SERVICE TO A SATISFIED CLIENTELE

PRECISION THERMOMETER & INSTRUMENT CO.

Authorized Agents in the United States
for Alexander Wright & Co., Ltd., of Westminster, London, Eng.
(Owners of the Simmance and Abady Patents)

PRECISION
Multiple Dead Beat Draft Gauge with Three Dials in One Case

PRECISION
Multiple Dead Beat Draft Gauge with Two Dials in One Case

The Wright Line includes their Single and Multiple Dead Beat Draft Gauges, in which the Simmance patents are employed, and which have a world-wide reputation. They are unusually "dead-beat," very accurate, and especially designed for boiler-front use. Made with one to five dials.

The standard ranges of the Multiple Gauge with three dials are 0 to 6 inches of water for Ash Pit pressure, 1-0-1 for the Fire Box, and 0 to 2 for the Last Pass.

The Multiple Gauge with two dials shows 1-0-1 for the Fire Box Draft and 0 to 2 inches of water for the Last Pass.

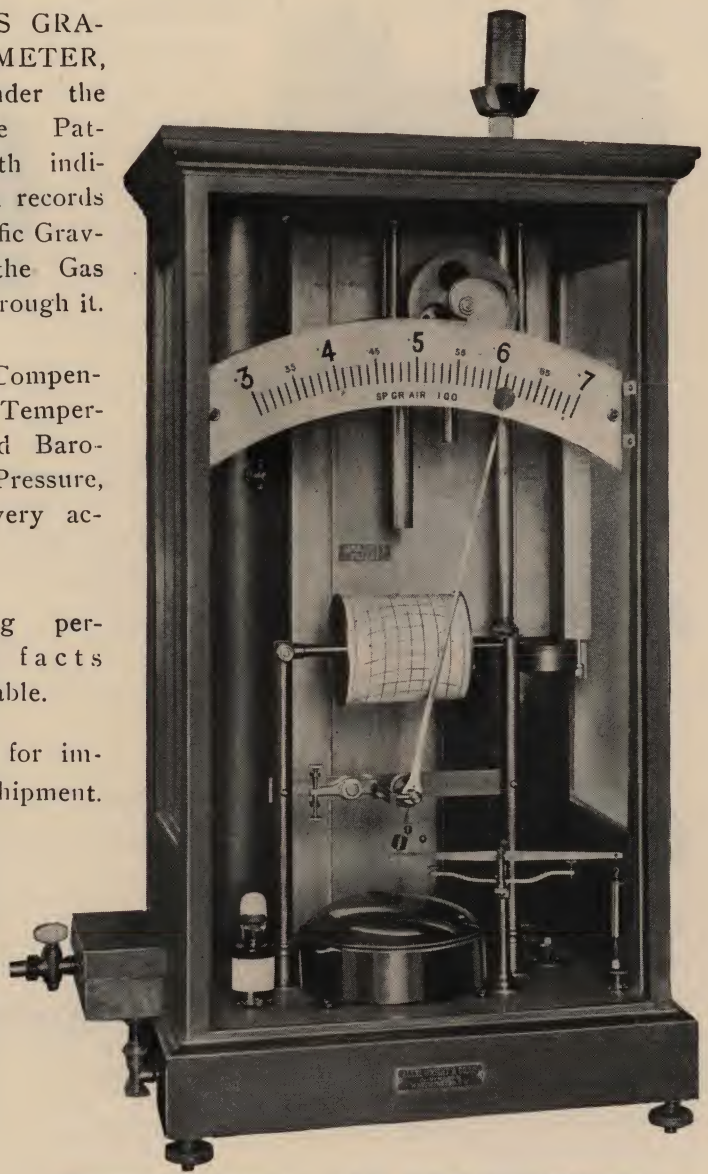
Any other combination involving a total range of eight inches of water column can be furnished.

The GAS GRAVITOMETER, made under the Simmance Patents, both indicates and records the Specific Gravity of the Gas passed through it.

It is Compensated for Temperature and Barometric Pressure, and is very accurate.

Interesting performance facts are available.

In stock for immediate shipment.



Simmance Patents—GAS GRAVITOMETER

M. T. DAVIDSON COMPANY

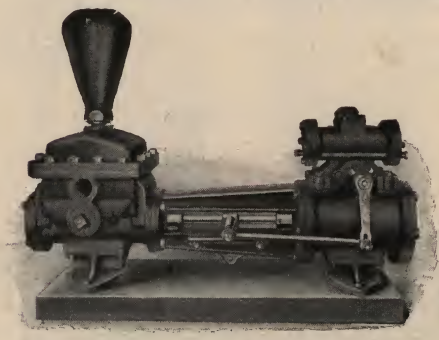
154 NASSAU STREET — NEW YORK CITY

"DAVIDSON" PUMPS

For All Service In Gas Plants

"DAVIDSON" PRESSURE OR BOILER FEED PUMPS

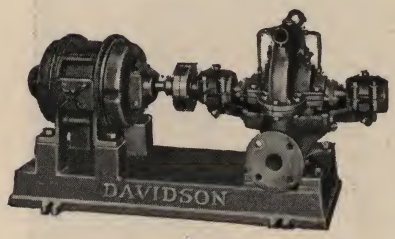
*PACKED PISTON PATTERN**



For pressure of 150 lbs. (If specially ordered, these pumps can be furnished for 250 pounds working pressure.)

** Outside Packed Plunger Boiler Feed Pumps Also Built*

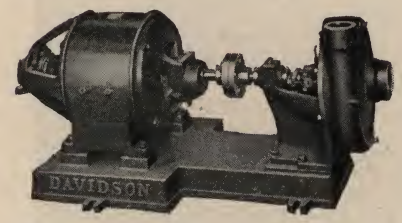
"DAVIDSON" CENTRIFUGAL PUMPS



Horizontally Split Double Suction.

Illustration shown here is Type AYE.

"DAVIDSON" CENTRIFUGAL PUMPS



Vertically Split Side Suction.

Illustration shown here is Type AOE.

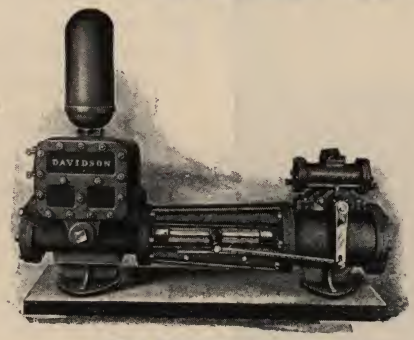
Please send for general catalogue. Prices and drawings on request; when making inquiry give data stating liquid to be pumped, discharge pressure, suction lift, steam pressure.
For motor driven pumps please give characteristics of electric current.

"DAVIDSON" OIL AND NAPHTHA PUMPS

Especially designed and fitted for pumping fuel oil, naphtha, etc.

Special Design for Heavy Oil

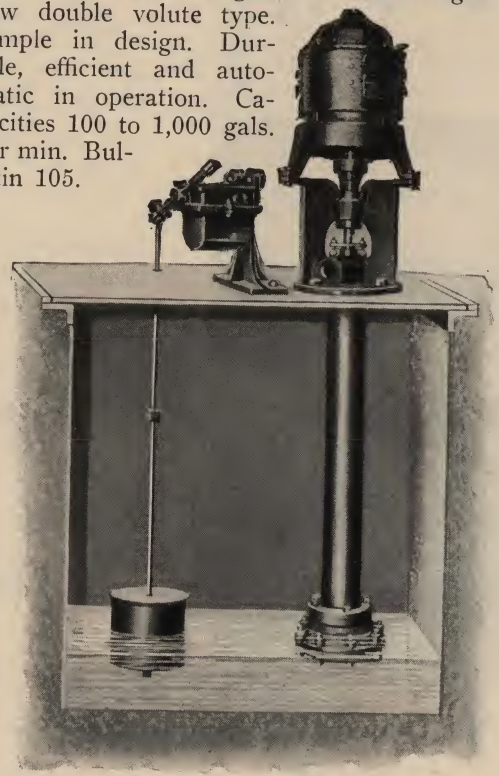
"DAVIDSON" TAR PUMPS



Especially designed and fitted for pumping tar and ammoniacal liquor. Pumps of special proportions for heavy pressure up to 300 lbs. per square inch can be furnished.

"DAVIDSON" SUMP PUMPS

are single stage, single inlet centrifugals of a new double volute type. Simple in design. Durable, efficient and automatic in operation. Capacities 100 to 1,000 gals. per min. Bulletin 105.



Distribution Section

American Gas Catalog and Handbook

The important charts, which were first published in the 1928 American Gas Catalog, for the determination of the flow of gas in high and low pressure lines, are repeated in this edition. These are very useful and convenient for accurately calculating the quantity of gas delivered, the pressures required, the size of pipe, etc.

Among the many new features added to the Section this year are details of welding pipe, showing the manner in which different kinds of welds are made and giving the properties of the various welded joints as well as instructions on making bends, etc.

Attention is also called to the table on storage capacity of pipes and the examples showing how this table can be advantageously employed to determine storage capacity of a main and to make temperature and barometric corrections.

Tables on dimensions, etc., of standard flange pipe and the bell and spigot pipe are also given.

Amongst other interesting features are tables on quantity of gas per mile of length of main, dimensions of pipe, temperature conversion, mathematical calculations, etc.

WELDING PIPE

Oxy-acetylene welding of steel pipe is carried out in a number of different ways and five different types of joints are produced, viz.:

1. Butt weld.
2. Normal socket (bell and spigot) joint.
3. Socket joint with groove.
4. Socket joint with welded rivets (welding with pinholes).

The details of these joints are shown in the accompanying illustrations.

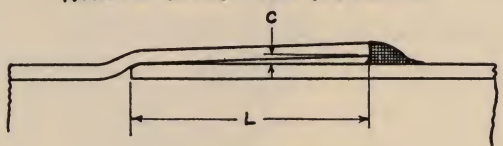
Butt Weld Joint

The single vee butt joint (Fig. 1) is the standard in welded field construction and is almost universally used for joining pipe. The preparation consists simply of machine beveling the ends of the pipe, generally at the mills, to 45 degrees, making a 90-degree included angle, when two ends are butted. This bevel does not extend completely to the inside of the pipe wall, there being an unbeveled portion at the inner side approximately 1/32-inch to 1/16-inch thick, depending upon the pipe size.

BUTT JOINT FOR WELDING

Fig. 1

NORMAL SOCKET FOR WELDING



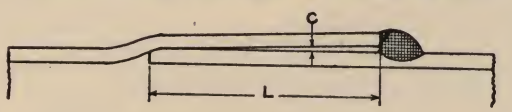
SIZE	DEPTH OF SOCKET L	SPACE BETWEEN TUBE AND SOCKET C
4" O.D.	2 7/4"	3/64"
8" O.D.	3 1/8"	1/16"
12" O.D.	4 3/4"	3/32"
16" O.D.	5 1/8"	3/32"

Fig. 2

Normal Sockets (B. & S.) Joints

This joint, termed the normal socket joint, consists essentially of a bell and spigot design (Fig. 2) in which one end of a pipe section is expanded so that the plain end of the pipe to be joined may be inserted.

SOCKET JOINT FOR WELDING WITH GROOVE



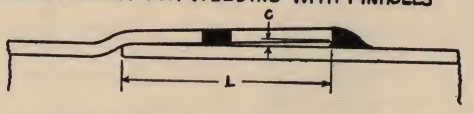
SIZE	DEPTH OF SOCKET L	SPACE BETWEEN TUBE AND SOCKET C
4" O.D	4"	3/64"
8" O.D	4"	1/16"
12" O.D	4"	3/32"
16" O.D	4"	3/32"

Fig. 3

Socket Joint With Groove

This joint is essentially the same as the normal socket joint, except that a slight groove is machined in the spigot end where the weld is to be made (Fig. 3).

SOCKET JOINT FOR WELDING WITH PINHOLES



SIZE	DEPTH OF SOCKET L	SPACE BETWEEN TUBE AND SOCKET C	DIAMETER OF HOLES FOR WELDING PLUGS	NUMBER OF HOLES FOR WELDING PLUGS
4" O.D	3 5/16"	3/64"	5/8"	2
8" O.D	3 5/16"	1/16"	5/8"	3
12" O.D.	3 5/16"	3/32"	7/8"	4
16" O.D.	3 5/16"	3/32"	7/8"	6

Fig. 4

Socket With Welded Rivets

This joint is essentially the same as normal socket joint, except that holes are punched in the bell for rivet welding (Fig. 4).

Templet Layout for 60° Turn

Consider the laying out of the templet for cutting pipe to make a 60° turn (Figure 5). Two views are all that are necessary for developing this pattern; a side view or elevation, and an end view or profile. The side view, Fig. 5-B, shows the line a-i, the miter line or line of intersection of the surfaces. It is this

line that marks the limit of the various ordinates or elements a-a, b-b, c-c, etc., which are used for measuring the templet. But it is also necessary to determine where these ordinates should be drawn in the side view. The end view or profile of the pipe (Fig. 5-A) shows how the location of the various ordinates are established. The circle a-b, etc., is divided into

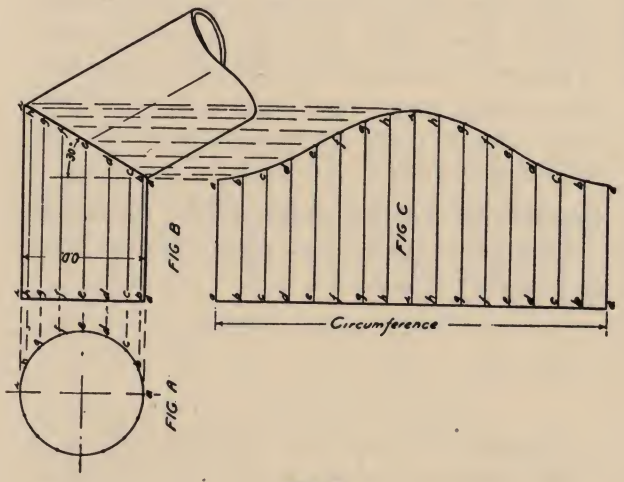


Fig. 5

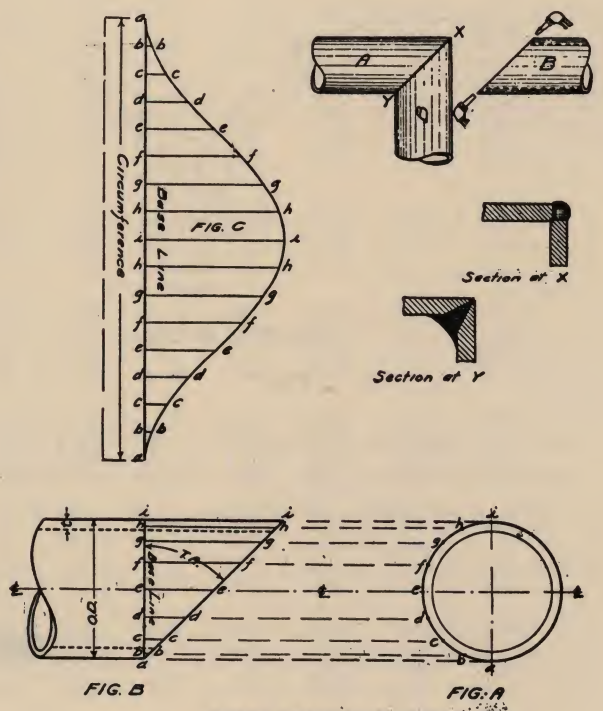
a number of equal parts. These points locate the equally spaced parallel ordinates around the circumference of the pipe. By producing the points from Fig. 5-A to Fig. 5-B, by means of horizontal parallel lines, their positions in the side view are shown. The arc distances e-f, or f-g, etc. (Fig. 5-A), are the distances the ordinates are apart. Their lengths e-e, f-f, g-g, etc., are shown in Fig. 5-B.

To lay out the templet, imagine the pipe a-a-i-i to be split at the bottom along the line a-a and stretched out or folded out flat. Fig. 5-C shows this condition. This is the templet. The ordinate lines are equally spaced the distance shown in Fig. 5-A, and their lengths are those shown in Fig. 5-B.

In using any templet, consideration must be given to the method of making the cut with the oxy-acetylene cutting blowpipe. For instance, in using the templet for the 60 degree turn the cut on the pipe should be made with the blowpipe held in such a position as to produce a miter cut. This is important if a well matched joint is to result. With the exception of angle turns, the templets are developed for a square cut; that is, the cut should be made with the blowpipe flame held radially to the pipe at all points of the cut. This is the normal way of cutting.

Procedure for Laying Out Templet for 90° Turn

Draw center line (CL) and describe a circle (Fig. 6-A) with diameter equal to O.D. of pipe. This is the end view or profile of the pipe. Divide one-half of the circle into a number of equal parts (usually eight): a-b-, b-c, c-d, etc. The greater the number of these



Templet Layout for 90° Turn or Ell

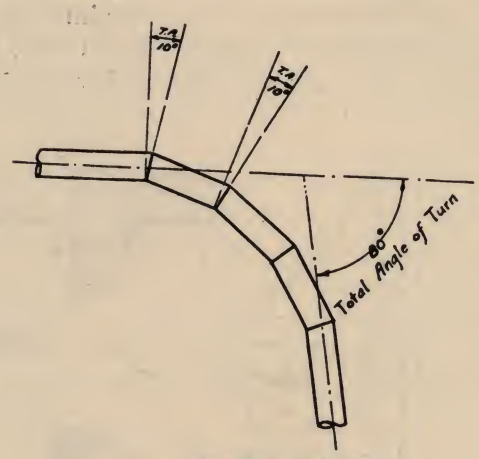
Fig. 6

divisions, the more accurate will be the results. These points establish the location of the elements or ordinates around the pipe.

Draw side view of the pipe (Fig. 6-B) by producing points a and i to left and draw base line on same view of pipe. Lay off templet angle (T.A.) with protractor, and draw the miter or joint line a-i. For this case of 90 degrees turn, the templet angle is 45 degrees. Produce points a, b, c, etc., from circle across side view of pipe. The distances a-a-, b-b, c-c, d-d, etc. (Fig. 6-B), are the lengths of the respective elements or ordinates of the templet.

Templet

Lay off a stretchout or base line, a-a (Fig. 6-C) equal to the external circumference of the pipe, and divide each half of it into the same number of equal parts as for the half circle. Through these divisions, at right angles to the base line, draw ordinate or measuring lines as shown, and lay off a-a,



Five-Piece 80° Bend

Fig. 7

b-b, c-c, etc., on the templet from the corresponding line in Fig. 6-B. Draw a smooth curve connecting the points. This curve is the templet line for cutting this pipe size and angle of turn.

About 4 inches of pattern material should be left below the base line in cutting out the templet in order to give stability and body to the pattern.

Templet for Angle of Turn Employing Two or More Pieces

The procedue for laying out the templet for any total angle of turn and any number of pieces is the same as in Fig. 10, except that the templet angle will vary. The templet angle can be found for any condition by the following formula:

Formula for Templet Angle (T.A.) for Bends

Templet angle for any total angle of bend and number of cuts:

$$\text{T.A.} = \frac{\text{Total angle of bends}}{\text{Twice the number of cuts}}$$

Example: To find the templet angle for a 5-piece 80-degree bend. In a 5-piece 80-degree bend there are four cuts:

$$\text{Therefore, TA.} = \frac{80}{2 \times 4} = 10°$$

COST DATA ON OXY-ACETYLENE WELDED JOINTS

Pipe Size	2″	3″	4″	6″	8″	10″	12″	16″	20″
Time per weld.....	4 -Min.	5.8 -Min.	9.4 -Min.	15.9 -Min.	19.4 -Min.	26.9 -Min.	35.1 -Min.	44 -Min.	90 -Min.
Rate of acetylene flow per hour.....	20 C.F.	26 C. F.	28	29	35	36	37	40	47
Amount of acetylene per weld	1.32	2.5	4.4	7.7	11.3	16.2	21.5	29.3	70.5
Rate of oxygen flow per hour.....	19	24	26	28	33	35	36	38	45
Amount of oxygen per weld	1.3	2.32	4	7.4	10.7	15.7	21.1	27.9	67.5
Amount of wire per weld in pounds.....	.15	.2	.3	.7	.9	1.1	1.4	1.7	3
Cost of acetylene per weld	.027	.055	.098	.1172	.252	.361	.479	.653	1.57
Cost of oxygen per weld	.013	.023	.04	.074	.107	.156	.211	.279	.675
Cost of wire per weld..	.023	.032	.048	.112	.144	.176	.224	.272	.48
Cost of labor, welder only	.04	.058	.094	.159	.194	.269	.351	.44	.90
TOTAL COST.....	.103	.168	.28	.513	.667	.96	1.265	1.64	.362

CONVERSION TABLES

OF FAHRENHEIT AND CENTIGRADE SCALES

Cent.	Fahr.	Cent.	Fahr.	Cent.	Fahr.	Cent.	Fahr.	Cent.	Fahr.	Cent.	Fahr.	Cent.	Fahr.
0	32	230	446	460	860	690	1274	920	1688	1150	2102	1380	2516
5	41	235	455	465	869	695	1283	925	1697	1155	2111	1385	2525
10	50	240	464	470	878	700	1292	930	1706	1160	2120	1390	2534
15	59	245	473	475	887	705	1301	935	1715	1165	2129	1395	2543
20	68	250	482	480	896	710	1310	940	1724	1170	2138	1400	2552
25	77	255	491	485	905	715	1319	945	1733	1175	2147	1405	2561
30	86	260	500	490	914	720	1328	950	1742	1180	2156	1410	2570
35	95	265	509	495	923	725	1337	955	1751	1185	2165	1415	2579
40	104	270	518	500	932	730	1346	960	1760	1190	2174	1420	2588
45	113	275	527	505	941	735	1355	965	1769	1195	2183	1425	2597
50	122	280	536	510	950	740	1364	970	1778	1200	2192	1430	2606
55	131	285	545	515	959	745	1373	975	1787	1205	2201	1435	2615
60	140	290	554	520	968	750	1382	980	1796	1210	2210	1440	2624
65	149	295	563	525	977	755	1391	985	1805	1215	2219	1445	2633
70	158	300	572	530	986	760	1400	990	1814	1220	2228	1450	2642
75	167	305	581	535	995	765	1409	995	1823	1225	2237	1455	2651
80	176	310	590	540	1004	770	1418	1000	1832	1230	2246	1460	2660
85	185	315	599	545	1013	775	1427	1005	1841	1235	2255	1465	2669
90	194	320	608	550	1022	780	1436	1010	1850	1240	2264	1470	2678
95	203	325	617	555	1031	785	1445	1015	1859	1245	2273	1475	2687
100	212	330	626	560	1040	790	1454	1020	1868	1250	2282	1480	2696
105	221	335	635	565	1049	795	1463	1025	1877	1255	2291	1485	2705
110	230	340	644	570	1058	800	1472	1030	1886	1260	2300	1490	2714
115	239	345	653	575	1067	805	1481	1035	1895	1265	2309	1495	2723
120	248	350	662	580	1076	810	1490	1040	1904	1270	2318	1500	2732
125	257	355	671	585	1085	815	1499	1045	1913	1275	2327	1505	2741
130	266	360	680	590	1094	820	1508	1050	1922	1280	2336	1510	2750
135	275	365	689	595	1103	825	1517	1055	1931	1285	2345	1515	2759
140	284	370	698	600	1112	830	1526	1060	1940	1290	2354	1520	2768
145	293	375	707	605	1121	835	1535	1065	1949	1295	2363	1525	2777
150	302	380	716	610	1130	840	1544	1070	1958	1300	2372	1530	2786
155	311	385	725	615	1139	845	1553	1075	1967	1305	2381	1535	2795
160	320	390	734	620	1148	850	1562	1080	1976	1310	2390	1540	2804
165	329	395	743	625	1157	855	1571	1085	1985	1315	2399	1545	2813
170	338	400	752	630	1166	860	1580	1090	1994	1320	2408	1550	2822
175	347	405	761	635	1175	865	1589	1095	2003	1325	2417	1555	2831
180	356	410	770	640	1184	870	1598	1100	2012	1330	2426	1560	2840
185	365	415	779	645	1193	875	1607	1105	2021	1335	2435	1565	2849
190	374	420	788	650	1202	880	1616	1110	2030	1340	2444	1570	2858
195	383	425	797	655	1211	885	1625	1115	2039	1345	2453	1575	2867
200	392	430	806	660	1220	890	1634	1120	2048	1350	2462	1580	2876
205	401	435	815	665	1229	895	1643	1125	2057	1355	2471	1585	2885
210	410	440	824	670	1238	900	1652	1130	2066	1360	2480	1590	2894
215	419	445	833	675	1247	905	1661	1135	2075	1365	2489	1595	2903
220	428	450	842	680	1256	910	1670	1140	2084	1370	2498	1600	2912
225	437	455	851	685	1265	915	1679	1145	2093	1375	2507	....	....

$$\text{Degrees Centigrade} \times 1.8 + 32 = \text{degrees Fahrenheit.}$$

$$\frac{\text{Degrees Fahrenheit} - 32}{1.8} = \text{degrees Centigrade.}$$

FLOW OF GAS IN PIPES

FLOW OF GAS IN LOW PRESSURE LINE

The accompanying diagram on the opposite page was designed from experimental data of the flow of gas in low-pressure lines. It may be represented by the formula

$$Q = 1910 \sqrt{\frac{D^5 H}{WL(1 + 3.6D + 0.3D)}}$$

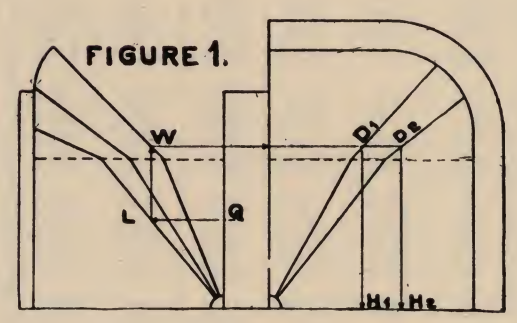
Where Q=discharge of free gas, cubic feet per hour.

D=diameter of pipe in inches.

H=friction drop of pressure, inches of water.

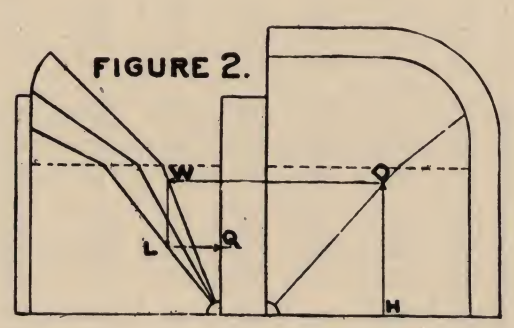
W=specific gravity of gas, air=1.

L=length of pipe in yards.



The diagram has four columns, marked in multiples of 10, for discharge readings, and corresponding four columns for diameter readings. In each problem read DISCHARGE and DIAMETER in column marked with same number.

To find diameter of pipe for given discharge follow the diagram in order indicated on Figure 1 by arrow heads from left to right: Q, L, W, D, P.



Start with Q, horizontally to L, vertically to W.

At this point follow horizontal line intersecting diameters in column identical with that of Q, for instance: D_1, D_2, D_3.

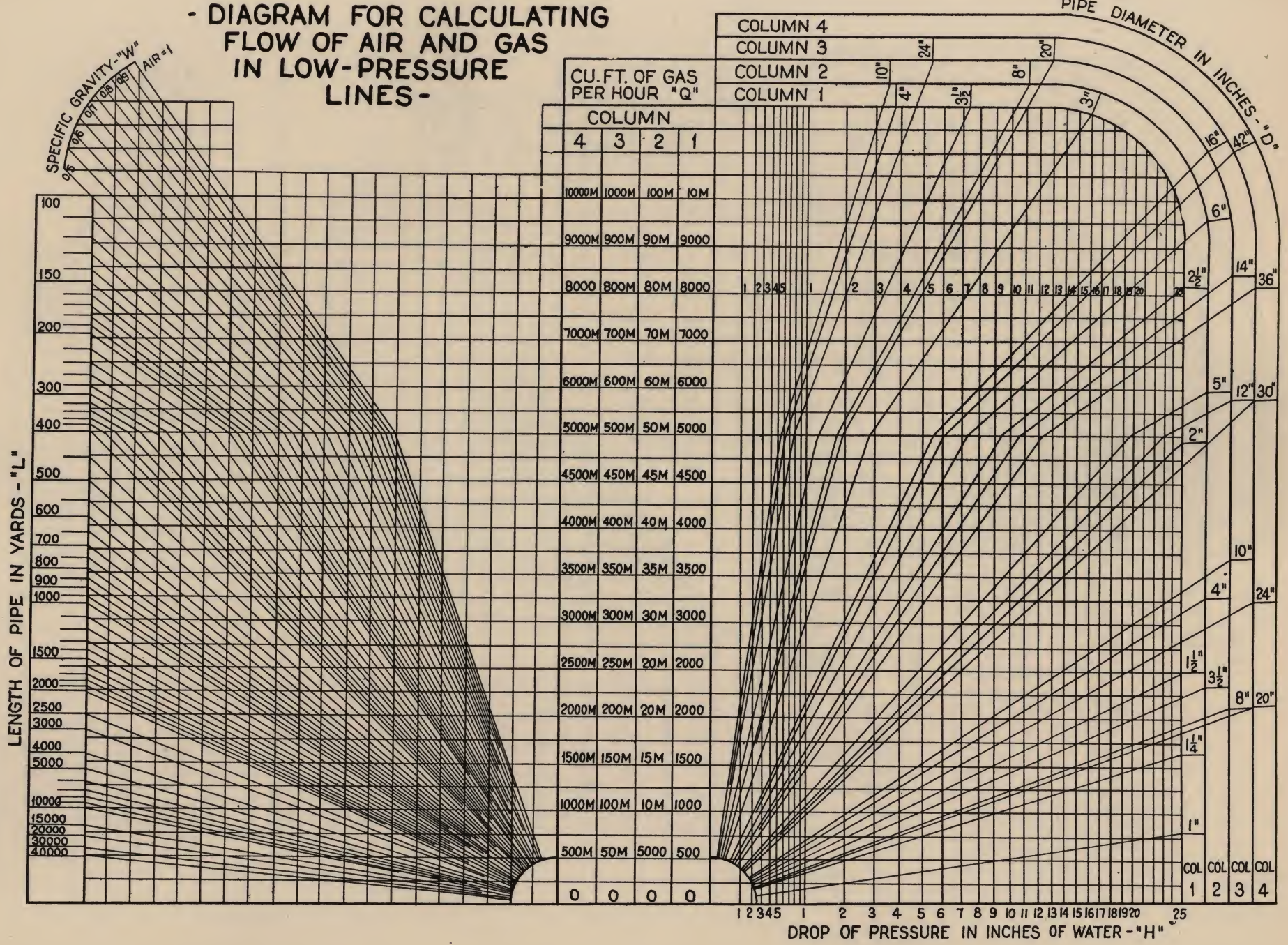
Take diameter corresponding to desired drop of pressure, viz.: H_1, H_2, or H_3.

To find discharge of gas through a given pipe follow the diagram in order indicated on Figure 2 by arrow heads from right to left: H, D, W, L, Q.

Start with H, vertically to D, horizontally to W, vertically to L.

The last horizontal line leads to the required quantity, Q. Read Q in cubic feet per hour in column identical with given diameter.

- DIAGRAM FOR CALCULATING FLOW OF AIR AND GAS IN LOW-PRESSURE LINES -

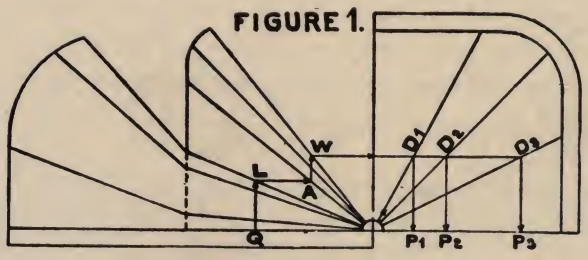


FLOW OF GAS IN HIGH PRESSURE LINES

The accompanying diagram was designed from experimental data of the flow of gas in high-pressure lines. It may be represented by the formula

$$Q = 64.3\sqrt{\frac{D^5 PA}{WL\,(1 + 3.6/D + 0.3D)}}$$

FIGURE 1.



Where Q=discharge of free gas, cubic feet per hour.

D=diameter of pipe in inches.

P=friction drop of pressure, pounds per square inch.

A=average pressure—initial plus final÷2=pounds absolute.

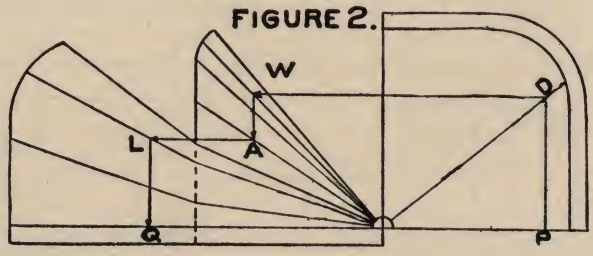
W=specific gravity of gas, air=1.

L=length of pipe in miles.

The diagram has four columns, marked in multiples of 10, for discharge readings, and corresponding four columns for diameter readings. In each problem read DISCHARGE and DIAMETER in column marked with same number.

To find diameter of pipe for a given discharge follow the diagram in order indicated on Figure 1, by arrow heads from left to right: Q, L, A, W, D. P.

FIGURE 2.



Start with Q, vertically to L, horizontally to A, vertically to W.

At this point follow horizontal line intersecting diameters in column identical with that of Q, for instance, D_1, D_2, D_3. Take diameter corresponding to desired drop of pressure, viz.: P_1, P_2, or P_3.

To find discharge of gas through a given pipe follow the diagram in order indicated on Figure 2 by arrow heads from right to left: P, D, W, A, L, Q.

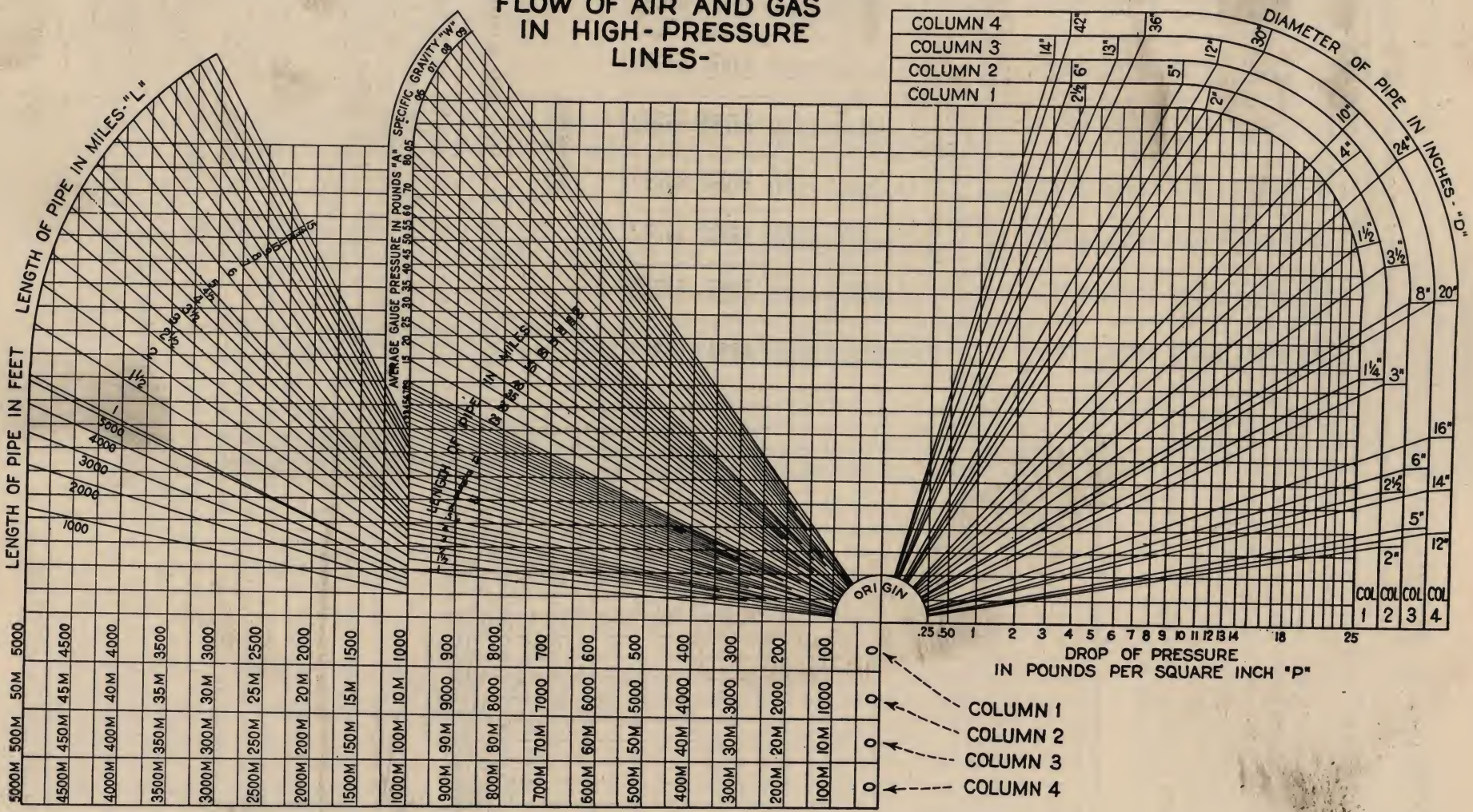
Start with P, vertically to D, horizontally to W, vertically to A, horizontally to L.

The last vertical line leads to the required quantity, Q. Read Q in cubic feet per hour in column identical with given diameter.

LEAKING JOINTS REPORTED BY COMPANIES REPRESENTING BETWEEN 20,000 AND 25,000 MILE OF MAINS

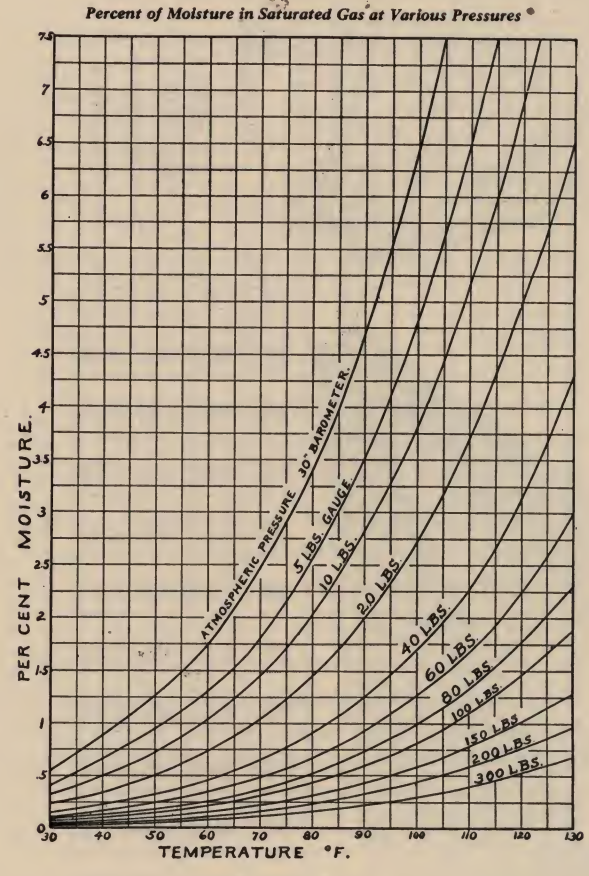
Type of Joint	Pressure	SIZE OF PIPE (Inches) 1¼	2	3	4	6	8	10	12	16	18	20	24	30	36	42	Total
Lead	Low	..	..	311	4974	3756	1592	381	844	520	2	398	343	23	2	..	13146
	Med. high	..	..	..	6	29	40	..	139	149	..	605	246	74	154	109	1551
Cement	Low	..	..	7	106	965	554	72	508	181	..	9	..	..	..	..	2437
	Med. high	..	..	..	6	5	17	4	18	33	..	74	30	16	19	..	198
Lead Wool	Low	..	..	..	19	86	64	1	62	2	..	8	..	11	..	..	242
	Med. high	..	..	..	8	16	..	..	33	121	..	92	2	..	108	..	380
Welded	Med. high	..	..	..	1	..	..	..	1	..	..	..	..	..	..	..	2
Screw	High	1	1	1	..	..	..	..	..	..	..	..	..	..	..	..	3
Flange	High	..	..	..	..	2	..	..	..	..	..	..	..	..	..	..	2
Long Screw	High	..	5	..	..	..	..	..	..	..	..	..	..	..	..	..	5

-DIAGRAM FOR CALCULATING FLOW OF AIR AND GAS IN HIGH-PRESSURE LINES-



MOISTURE IN SATURATED GAS

The percentage of moisture in saturated gas varies both with pressure and temperature. This variation is shown in diagrammatic form in the accompanying chart. Thus if the temperature of the gas is 85 degrees F. and it is desired to know what the percentage of moisture would be in the saturated gas at 30-inch barometric pressure, follow the 80-degree F. vertical line upward until it cuts the 50-inch curve, then follow to the left and read off 3.95



per cent. moisture. If the gas is cooled down to 60 degrees F. then the percentage of moisture contained in the saturated gas will be found in similar manner to be 1.75 per cent. If the pressure of the gas is increased to 20 lbs. gauge pressure while the temperature remains constant at 85 degrees F., then the 85 per cent. vertical is followed upward until it cuts the 20 lb. curve, and then to the left to read off 1.7 per cent. moisture. It is noted that an increase in pressure has the same effect as a decrease in temperature.

QUANTITY OF GAS PER MILE OF PIPE

Values are in thousands of cubic feet at a base pressure of 14.65 pounds absolute (four ounces).

Pressure pounds gage	4-ounce multipliers	Nominal diameter of pipe in inches					
		2	3	4	6	8	10
400	28.29	3.48	7.67	13.2	30.0	51.9	81.8
380	26.92	3.31	7.30	12.6	28.5	49.4	77.8
360	25.56	3.14	6.93	11.9	27.1	46.9	73.9
340	24.19	2.98	6.56	11.3	25.6	44.4	69.9
320	22.83	2.81	6.19	10.7	24.2	41.9	66.0
300	21.46	2.64	5.82	10.0	22.7	39.4	62.0
280	20.10	2.47	5.45	9.38	21.3	36.9	58.1
260	18.73	2.30	5.08	8.74	19.8	34.4	54.1
240	17.37	2.14	4.71	8.11	18.4	31.9	50.2
220	16.00	1.97	4.34	7.47	16.9	29.4	46.3
200	14.63	1.80	3.97	6.83	15.5	26.8	42.3
180	13.27	1.63	3.60	6.19	14.1	24.4	38.4
160	11.90	1.46	3.23	5.55	12.6	21.8	34.4
140	10.54	1.30	2.86	4.92	11.2	19.3	30.5
120	9.17	1.13	2.49	4.28	9.71	16.8	26.5
100	7.81	0.961	2.12	3.65	8.27	14.3	22.6
80	6.44	0.792	1.75	3.01	6.82	11.8	18.6
60	5.08	0.625	1.38	2.37	5.38	9.32	14.7
40	3.71	0.456	1.01	1.73	3.93	6.81	10.7
20	2.35	0.289	0.64	1.10	2.49	4.31	6.8

QUANTITY OF GAS PER MILE OF PIPE

Values are in thousands of cubic feet at a base pressure of 14.65 pounds absolute (four ounces).

Pressure pounds gage	4-ounce multipliers	Nominal diameter of pipe in inches					
		12	14	16	18	20	22
400	28.29	117.	143.	186.	242.	302.	368.
380	26.92	112.	136.	180.	231.	287.	350.
360	25.56	106.	129.	171.	219.	273.	332.
340	24.19	100.	122.	162.	207.	258.	315.
320	22.83	94.7	115.	153.	196.	244.	297.
300	21.46	89.0	109.	144.	184.	229.	279.
280	20.10	83.4	102.	135.	172.	215.	261.
260	18.73	77.7	94.7	125.	161.	200.	244.
240	17.37	72.0	87.8	116.	149.	185.	226.
220	16.00	66.0	80.9	107.	137.	171.	208.
200	14.63	60.7	74.0	98.0	125.	156.	190.
180	13.27	55.0	67.1	88.9	114.	142.	173.
160	11.90	49.0	60.2	79.7	102.	127	155.
140	10.54	43.7	53.3	70.6	90.3	112.	137.
120	9.17	38.0	46.4	61.4	78.6	97.9	119.
100	7.81	32.4	39.5	52.3	66.9	83.4	102.
80	6.44	26.7	32.6	43.1	55.2	68.7	83.8
60	5.08	21.1	25.7	34.0	43.5	54.2	66.1
40	3.71	15.4	18.8	24.8	31.8	39.6	48.2
20	2.35	9.7	11.9	15.7	20.1	25.1	30.6

FLOW OF GAS AND AIR FORMULAE

The following are formulae which can be used in calculating the flow of gas or air in pipes:

Quantity of gas, in cubic feet, discharged per hour by any main can be found as follows:

$$X = 1350\, d^2 \sqrt{h\, d \div S\, L}$$

Where—

h = pressure of gas in inches of water.
d = diameter of pipes in inches.
S = specific gravity of gas (air = 1)
L = length of pipe in yards.

(Dr. Pole.)

Another rule is—

$$X = 1000 \sqrt{d^5\, h \div S\, L}$$

(Molesworth's Pocket Book.)

And another is—

$$X = 1000 \sqrt{h\, d^5 \div \tfrac{1}{2}L}$$

(Spon's Pocket Book.)

The first is the most correct.

Flow of Air in Pipes. (Hawksley.)

Velocity in feet per second =

$$396 \sqrt{\text{head in inches of water} \times \text{diameter of pipe in feet} \div \text{length of pipe in feet}}$$

Head in inches of water = length of pipe in feet × velocity ÷ 156,800 diameter of pipe in feet.

Contents of pipe = square of diameter × .7854 × length; contents in cubic feet × 6.26 = gallons.

Weight of cast iron pipe = K ($D^2 - d^2$). K = (for cast iron) 2.5.

Flange equals, say, 1 foot of pipe in weight.

In a 24-inch pipe delivering 240,000 cubic feet per hour into one 18-inch pipe and two 14-inch pipes at a distance of about 2,000 yards the pressure was reduced from $\frac{47}{10}$ to $\frac{20}{10}$.

DIMENSIONS OF PIPES

Size	Inside Dia. Inches	PER ONE FOOT LENGTH			Capacity Per Mile, Cu. Ft.	National Coated, Wt. Per Ft.	
		Cu. Ft., also Area Sq. Ft.	Int'nl Surf. in Sq. Ft.	Weight, Lbs. Plain Ends		Single Wrapped	Double Wrapped
½	0.622	0.002	0.163	.850	10.5		
¾	0.824	0.004	0.216	1.130	21.1		
1	1.049	0.006	0.275	1.678	31.7		
1¼	1.380	0.010	0.361	2.272	52.8		
1½	1.610	0.014	0.422	2.717	73.9		
2-O. D.	1.810	0.017	0.474	1.932	89.7	2.300	2.400
2	2.067	0.023	0.541	3.652	121		
2½	2.469	0.033	0.646	5.793	174		
3-O. D.	2.782	0.042	0.728	3.365	222	3.900	4.100
3	3.068	0.051	0.803	7.575	269		
3½	3.548	0.068	0.929	9.109	359		
4-O. D.	3.744	0.077	0.980	5.293	407	6.000	6.300
4	4.026	0.088	1.054	10.790	465		
5-O. D.	4.732	0.122	1.239	6.963	644	7.900	8.200
5	5.047	0.139	1.321	14.617	734		
2-O. D.	5.720	0.178	1.498	8.762	939	9.900	10.300
6	6.065	0.201	1.588	18.974	1061		
8-O. D.	7.684	0.322	2.012	13.233	1700	14.800	15.300
8	7.981	0.347	2.089	28.554	1830		
10-O. D.	9.650	0.508	2.526	18.363	2682	20.400	21.000
10	10.020	0.548	2.623	40.483	2893		
12-O. D.	11.612	0.735	3.040	24.461	3880	27.000	27.700
12	12.000	0.785	3.142	49.562	4144		
14-O. D.	13.580	1.006	3.555	30.928	5311	33.900	35.000
15-O. D.	14.250	1.108	3.731	58.573	5850	38.200	39.500
16-O. D.	15.532	1.316	4.066	39.401	6948	42.900	44.200
18-O. D.	17.510	1.672	4.584	46.458	8828	50.400	51.800
20-O. D.	19.456	2.065	5.094	57.309	10903	61.900	63.400
22-O. D.	21.398	2.497	5.602	69.756	13184	75.000	76.600
24-O. D.	23.340	2.971	6.110	83.423	15686	89.300	91.100
26-O. D.	25.276	3.484	6.617	99.122	18395	105.700	107.900
28-O. D.	27.208	4.038	7.123	116.746	21320	124.100	126.400
30-O. D.	29.136	4.630	7.628	136.421	24446	144.600	147.000

NOTE—The effective storage capacity of a main only reaches the cubical contents when the pressure is approximately 15 lbs. above atmosphere or at 2 atmospheres absolute.

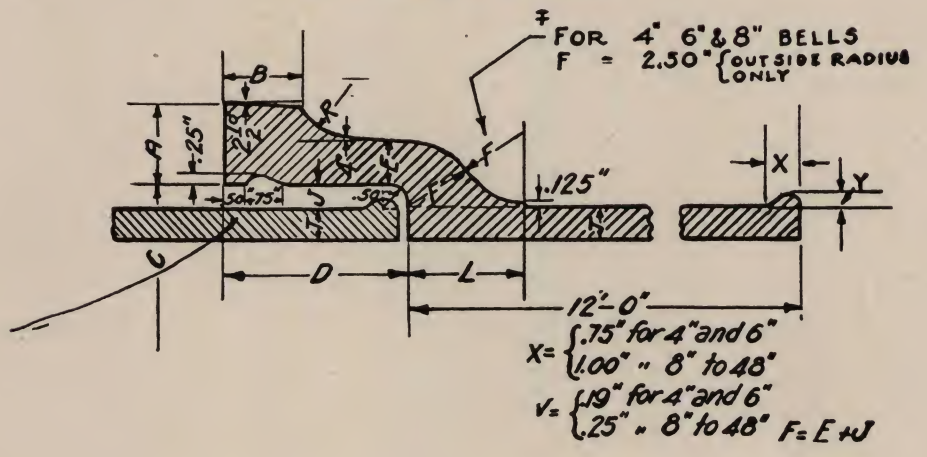
Similarly the storage is doubled at 30 lbs., one-third at 5 lbs., or one-fifteenth of the above figures for every 1 lb. pressure.

BELL AND SPIGOT PIPE AND SPECIAL CASTINGS

Nom. Diam., Inches	Actual Outside Diam., Inches	T	Inside Diam., Inches	Dimensions in inches A	B	C	D	E	F	J	L	R	Approx. Weight in Lbs. Bell †	Per Foot *	12" 0' Length
4	4.80	.40	4.00	1.30	1.50	5.80	4.00	.59	‡1.09	.50	3.25	.75	27.0	19.33	234
6	6.90	.43	6.04	1.40	1.50	7.90	4.00	.62	‡1.12	.50	3.25	.80	39.5	30.25	367
8	9.05	.45	8.15	1.50	1.50	10.05	4.00	.69	‡1.19	.50	3.25	.80	52.8	42.08	509
10	11.10	.49	10.12	1.50	1.50	12.10	4.00	.69	1.19	.50	2.10	.90	57.93	55.91	671
12	13.20	.54	12.12	1.60	1.50	14.20	4.50	.75	1.25	.50	2.20	1.00	79.47	73.83	886
16	17.40	.62	16.16	1.80	1.75	18.40	4.50	.90	1.40	.50	2.50	1.10	125.18	112.58	1351
20	21.60	.68	20.24	2.00	1.75	22.85	4.50	.97	1.60	.63	2.80	1.15	169.10	153.83	1846
24	25.80	.76	24.28	2.10	2.00	27.05	5.00	1.05	1.68	.63	2.80	1.25	235.10	206.41	2477
30	31.74	.85	30.04	2.30	2.00	32.99	5.00	1.15	1.78	.63	3.00	1.30	315.2	284.0	3408
36	37.96	.95	36.06	2.50	2.00	39.21	5.00	1.25	1.88	.63	3.20	1.40	410.2	379.25	4551
42	44.20	1.07	42.06	2.80	2.00	45.45	5.00	1.40	2.03	.63	3.40	1.45	537.5	497.66	5972
48	50.50	1.26	47.98	3.00	2.00	51.75	5.00	1.50	2.13	.63	3.60	1.60	657.0	663.5	7962

NOTE—Pipe heavier than these standards may be made by reducing the cores or internal diameters "C" and "D"; same for specials.
* Weight per foot includes Bell and Bead.
† Weight of Bell includes only metal beyond O. D. of pipe.
‡ See Sketch for Special outside radius dimensions for 4 in., 6 in., and 8 in. Bells.

BELL AND SPIGOT PIPE



SIZE OF SERVICE TO RUN TO APARTMENT HOUSES

No. of Apts.	Size of pipe for given length of service in feet. 20′	40′	50′	60′	70′	80′	90′	100′	110′	120′	130′	140′	150′	160′	170′	180′	190′	200′
4	2″	2″	2″	2″	2″	2″	2″	2″	2″	2″	2″	2″	2″	2″	2″	2″	2″	2″
8	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
10	2	2	2	2	2	2	2	2	2	2	2	2	2½	2½	2½	2½	2½	2½
12	2	2	2	2	2	2	2	2	2½	2½	2½	2½	2½	2½	2½	2½	2½	2½
14	2	2	2	2	2	2½	2½	2½	2½	2½	2½	2½	2½	2½	2½	2½	2½	2½
16	2	2	2	2½	2½	2½	2½	2½	2½	2½	2½	2½	2½	2½	2½	2½	2½	2½
20	2½	2½	2½	2½	2½	2½	2½	2½	2½	2½	2½	2½	2½	2½	2½	2½	2½	2½
24	2½	2½	2½	2½	2½	2½	2½	2½	3	3	3	3	3	3	3	3	3	3
30	2½	2½	2½	2½	2½	3	3	3	3	3	3	3	3	3	3	3	3	3
40	2½	2½	3	3	3	3	3	3	4	4	4	4	4	4	4	4	4	4
48	3	3	3	3	3	4	4	4	4	4	4	4	4	4	4	4	4	4

STANDARD FLANGES AND DRILLING

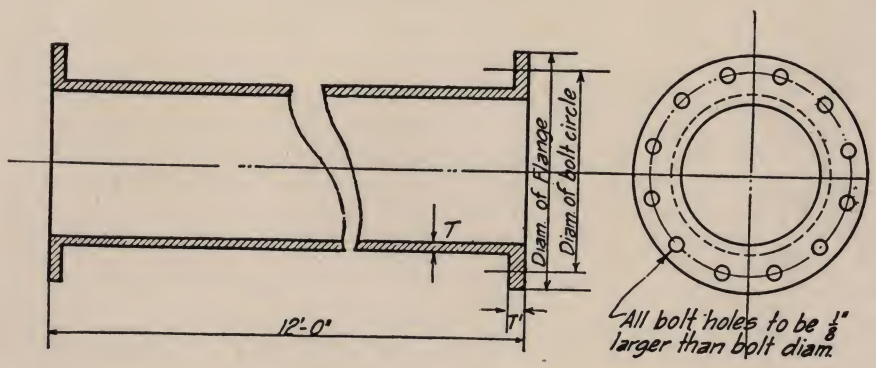
Standard Flanged Pipe

Dimensions in Inches

Nominal Diam., Inches	Actual Outside Diam., Inches	T	Actual Inside Diam., Inches	T′	Diameter of flange	Diameter of Bolt Circle	Size of Bolts	Number of Bolts	Approximate Weight in Pounds One Flange †	Flanged Pipe per Foot	12′ 0″ Length
4	4.80	.40	4.00	.72	9.00	7.125	5/8	4	8.19	18.62	223
6	6.90	.43	6.04	.72	11.00	9.125	5/8	4	10.46	29.01	348
8	9.05	.45	8.15	.75	13.00	11.125	5/8	8	12.65	40.05	481
10	11.10	.49	10.12	.86	16.00	13.75	5/8	8	22.53	54.71	656
12	13.20	.54	12.12	.875	18.00	15.75	5/8	8	25.96	71.34	856
16	17.40	.62	16.16	1.00	22.50	20.00	3/4	12	39.68	108.61	1303
20	21.60	.68	20.24	1.00	27.00	24.50	3/4	16	51.10	147.95	1775
24	25.80	.76	24.28	1.125	31.00	28.50	3/4	16	65.00	197.38	2369
30	31.74	.85	30.04	1.25	37.50	35.00	7/8	20	96.70	273.45	3281
36	37.96	.95	36.06	1.375	44.00	41.25	7/8	24	132.26	366.67	4400
42	44.20	1.07	42.06	1.56	50.75	47.75	1.0	28	186.83	483.48	5802
48	50.50	1.26	47.98	1.75	57.00	54.00	1.0	32	235.23	647.36	7768

NOTE—Pipe heavier than these standards may be made by reducing the cores or internal diameters.
† Weight of flange includes only metal beyond O. D. of pipe.
* Weight per foot includes flanges.

STANDARD FLANGED PIPE



EQUATIONS FOR PIPES

A series of constants have been derived, based on the fact that the carrying capacity of a pipe varies in accordance with the square root of the fifth power of the diameter for a given length and fricton loss. These constants can then be employed in determining the equivalent of a series of pipes. Thus, suppose it is necessary to determine the diameter of a pipe which is equivalent in carrying capacity to pipes of one inch diameter, one and one-quarter inch diameter, and one and one-half inch diameter.

The proper constants are obtained from the following tabulation and are added together

as follows: 0.548 + 1.18 + 1.83 = 3.55. Then the nearest constant to the value of 3.55 is located in the same tabulation and this is seen to be 3.728. The constant which is more than 3.54 is the one selected. This constant then corresponds to a pipe diameter of two inches.

Diameter of Pipe Inch	Constant
0.5	0.1162
0.75	0.2628
1	0.5376
1.25	1.178
1.5	1.829
2	3.728
2.5	6.118
3	11.21
3.5	16.74
4	23.71
5	43.81
6	71.65
8	149.8
10	160.2

USEFUL DATA ON LAYING MAINS

Internal Diam. of Pipe In.	Length of Pipe Ft.	Thickness In.	Weight per Pipe Cwt.	Qr.	Lbs.	Lead Required Lbs.	Yarn Needed Lbs.	Lead Wool Lbs.	Oz.	Yarn Lbs.	Oz.
3	9	.38	1	0	17	2.75	.10	1	10	..	3.75
3	12	.39	1	3	26	4.0	.14	2	2	..	4.5
6	12	.43	3	1	4	6.75	.21	3	12	..	8.5
9	12	.49	5	2	9	11.5	.30	6	6	1	0
12	12	.57	8	1	6	18.5	.42	9	9	1	9
16	12	.65	12	2	7	28.0	.60	13	5	2	8
20	12	.73	17	2	11	36.0	1.00	17	9	3	5
24	12	.80	23	1	0	48.0	1.75	20	12	4	0
30	12	.89	31	3	26	60.0	2.50	..	..	..	..
36	12	.98	42	0	4	72.0	3.00	..	..	..	..
42	12	1.06	42	3	19	84.0	3.60	..	..	..	..
48	12	1.13	64	2	24	94.0	4.00	..	..	..	..

INSTRUCTIONS FOR TESTING METERS

To arrive at accurate results in testing gas meters necessitates very close attention to a great many details. Merely connecting a meter to the prover, passing a small quantity of air or gas through it, without strict regard to the following rules, will result in simply an approximation, not a correct test.

To test a meter accurately the prover must be mathematically correct, must be perfectly level, duly counterpoised and adjusted so as to give uniform pressure from top to bottom during the movement of the bell in the tank. The water in the prover, the air or gas in the bell, and also the meter to be tested, must all be uniform in temperature with the air of the room in which the tests are to be made,

SPECIFIC GRAVITY OF WATER AT VARIOUS TEMPERATURES

Temp. in Degrees Celsius	Temp. in Degrees Fahr.	Specific Gravity Water at 4°C. = 1	1 cu. ft. weighs, lbs.	Temp. in Degrees Celsius	Temp. in Degrees Fahr.	Specific Gravity Water at 4°C. = 1	1 cu. ft. weighs, lbs.
0	32	.999874	62.42	55	131	.98579	61.54
4	39.2	1.000000	62.42	60	140	.98331	61.37
10	50	.999736	62.41	65	149	.98067	61.20
15	59	.999143	62.37	70	158	.97790	61.02
20	68	.998252	62.32	75	167	.97495	60.83
25	77	.997098	62.26	80	176	.97191	60.64
30	86	.995705	62.17	85	185	.96876	60.44
35	95	.994098	62.08	90	194	.96550	60.22
40	104	.99233	61.97	95	203	.96212	60.00
45	113	.99035	61.85	100	212	.95863	59.76
50	122	.98813	61.70				

and all of these temperatures must be kept uniform during the entire test.

The meter or meters to be tested should be brought to the proving room at least five hours (if possible, ten hours or longer) before making tests, thereby giving the meters themselves an opportunity to become adjusted to room temperature, and after insuring that all conditions described above are properly taken care of, testing can be commenced.

After filling the holder with air or gas, connect the meter, making sure that all connections are tight, and then run through the meter a small quantity of air or gas (preferably on the up-stroke of the hand) so that the proving hand will rest exactly on one of the divisions of the index circle, generally termed the "proving head" of the meter. Refill tank, if necessary, and by means of adjustment valve set the pointer on tank to 0 (or to any other convenient point on scale), then open prover cock and start testing, making either 2 ft. or 4 ft. run should you be testing a 3 lt. or a 5 lt. meter, shutting off prover when proving hand shows that the 2 or 4 ft. have passed through. If the quantity registered by the meter exactly corresponds with that taken from the prover, the meter is correct, but if more or less, the percentage of error is easily determined.

Meters are usually tested with initial pressure of from 1½ to 2 in. at inlet pipe (be sure that inlet pipe has ample capacity to take care of size of meter being tested), and tests are usually made under two different speeds—one with full open outlet of meter, the other with a check opening, restricting the different meters to the following capacities on this check opening:

3 lt.....18 ft. per hour
5 lt.....30 ft. per hour
10 lt.....60 ft. per hour

(Larger sizes in proportion.)

It will be noted from the above that each meter sould be tested under two different rates of speed, the purpose being to assure uniformity of proof for whatever speed the meter may meet while in service.

In proving meters there are two necessary adjustments required: It is necessary at times to melt the solder holding the tangent to the top of the crank, altering slightly the position of the tangent for the purpose of securing uniformity of action between the diaphragm stroke and the valve movement. This adjustment is made whenever the proof tests under the two different rates of speed do not agree, and is made only for the purpose of bringing

these separate tests together. After having the speed tests correct to agree one with the other, it is usually necessary to change the position of the tangent bar by moving it either in or out, as may be required to make the meter register either faster or slower.

Ordinarily in figuring the percentage of error on the meter, the reading of the prover is taken, and the error is reached without calculation for absolute figures. This is not entirely correct for the following reason: Suppose we are testing a 5 lt. meter, running only 2 ft. of gas through the meter in making tests. If the scale shows that 2.05 cu. ft. have been used in this test, that is, the prover registering 2.05 cu. ft. the meter registering 2 cu. ft., the meter would ordinarily be called 2½ per cent slow. As a matter of fact, the correct figure would be .05 divided by 2.05 or 2.44 per cent slow. In this same test, had the prover shown only 1.95 cu. ft. with the meter registering 2 cu. ft., the meter would ordinarily be called 2½ per cent fast, but correctly it would be .05 divided by 1.95, or 2.66 per cent fast.

Circumferences and Areas of Circles from ⅛ to 20

Diam.	Circum.	Area	Diam.	Circum.	Area
⅛	.3927	.012272	5	15.708	19.635
¼	.7854	.049087	5⅛	16 1007	20.629
⅜	1.1781	.110447	5¼	16.4934	21.6476
½	1 5708	.19635	5⅜	16.8861	22.6907
⅝	1.9635	.306796	5½	17.2788	23.7583
¾	2.3562	.441787	5⅝	17.6715	24.8505
⅞	2.7489	.601322	5¾	18.0624	25.9673
			5⅞	18.4569	27.1086
1	3.1416	.7854	6	18.8496	28.2744
1⅛	3.5343	.99402	6⅛	19.2423	29.4648
1¼	3.927	1.2272	6¼	19.635	30.6797
1⅜	4.3197	1.4849	6⅜	20 0277	31.9191
1½	4.7124	1.7671	6½	20.4204	33.1831
1⅝	5.1051	2.0739	6⅝	20.8131	34.4717
1¾	5.4987	2.4053	6¾	21.2058	35.7848
1⅞	5.8905	2.7612	6⅞	21.5985	37.1224
2	6.2832	3.1416	7	21.9912	38.4846
2⅛	6.6759	3.5466	7⅛	22 3839	39.8713
2¼	7.0686	3,9761	7¼	22.7766	41.2826
2⅜	7.4613	4.4301	7⅜	23.1693	42.7184
2½	7.854	4.9087	7½	23.562	44.1787
2⅝	8.2467	5.4119	7⅝	23.9547	45.6636
2¾	8.6394	5.9396	7¾	24.3474	47.1731
2⅞	9.0321	6.4918	7⅞	24.7401	48.7071
3	9.4248	7.0686	8	25.1328	50.2656
3⅛	9.8175	7.6699	8⅛	25.5255	51.8487
3¼	10.2102	8.2958	8¼	25.9182	53.4563
3⅜	10.6029	8.9462	8⅜	26.3109	55.0884
3½	10.9956	9.6211	8½	26.7036	56.7451
3⅝	11.3883	10.3206	8⅝	27.0963	58.4264
3¾	11.781	11.0447	8¾	27.489	60.1322
3⅞	12.1737	11.7933	8⅞	27.8817	61.8625
4	12.5664	12.5664	9	28 2744	63.6174
4⅛	12.9591	13.3641	9⅛	28.6671	65.3968
4¼	13 3518	14.1863	9¼	29.0598	67.2008
4⅜	13.7445	15.033	9⅜	29.4525	69.0293
4½	14.1372	15.9043	9½	29.8452	70.8823
4⅝	14.5299	16.8002	9⅝	30.2379	72 7599
4¾	14.9226	17.7206	9¾	30.6306	74.6621
4⅞	15.3153	18.6555	9⅞	31.0233	76.5888

Circumferences and Areas of Circles from ⅛ to 20

Diam.	Circum.	Area	Diam.	Circum.	Area
10	31.416	78.54	15	47.124	176.715
10⅛	31.8087	80.5158	15⅛	47.5167	179.673
10¼	32.3014	82.5161	15¼	47.9094	182.655
10⅜	32.5941	84.5409	15⅜	48.3021	185.661
10½	32.9868	86.5903	15½	48.6948	188.692
10⅝	33.3795	88.6643	15⅝	49.0875	191.748
10¾	33.7722	90.7628	15¾	49.4802	194.828
10⅞	34.1649	92.8858	15⅞	49.8729	197.933
11	34.5576	95.0334	16	50.2656	201.062
11⅛	34.9503	97.2055	16⅛	50.6583	204.216
11¼	35.343	99.4022	16¼	51.051	207.395
11⅜	35.7357	101.6234	16⅜	51.4437	210.598
11½	36.1284	103.8691	16½	51.8364	213.825
11⅝	36.5211	106.1394	16⅝	52.2291	217.077
11¾	36.9138	108.4343	16¾	52.6218	220.354
11⅞	37.3065	110.7537	16⅞	53.0145	223.655
12	37.6996	113.098	17	53.4072	226.981
12⅛	38.0919	115.466	17⅛	53.7999	230.331
12¼	38.4846	117.859	17¼	54.1926	233.906
12⅜	38.8773	120.277	17⅜	54.5853	237.105
12½	39.27	122.719	17½	54.978	240.529
12⅝	39.6627	125.185	17⅝	55.3707	243.977
12¾	40.0554	127.677	17¾	55.7634	247.45
12⅞	40.4481	130.192	17⅞	56.1561	250.948
13	40.8408	132.733	18	56.5488	254.47
13⅛	41.2335	135.297	18⅛	56.9415	258.016
13¼	41.6262	137.887	18¼	57.3342	261.587
13⅜	42.0189	140.501	18⅜	57.7269	265.183
13½	42.4116	143.139	18½	58.1196	268.803
13⅝	42.8043	145.802	18⅝	58.5123	272.448
13¾	43.197	148.49	18¾	58.905	276.117
13⅞	43.5897	151.202	18⅞	59.2977	279.811
14	43.9824	153.938	19	59.6904	283.529
14⅛	44.3751	156.7	19⅛	60.0831	287.272
14¼	44.7678	159.485	19¼	60.4758	291.04
14⅜	45.1605	162.296	19⅜	60.8685	294.832
14½	45.5532	165.13	19½	61.2612	298.648
14⅝	45.9459	167.99	19⅝	61.6539	302.489
14¾	46.3386	170.874	19¾	62.0466	306.355
14⅞	46.7313	173.782	19⅞	62.4393	310.245
			20	62.832	314.16

DECIMALS OF AN INCH FOR EACH 1/64TH

1/32nds	1/64ths	Decimal	Fraction	1/32nds	1/64ths	Decimal	Fraction
	1	.015625			33	.515625	
1	2	.03125		17	34	.53125	
	3	.046875			35	.546875	
2	4	.0625	1—16	18	36	.5625	9—16
	5	.078125			37	.578125	
3	6	.09375		19	38	.59375	
	7	.109375			39	.609375	
4	8	.125	1—8	20	40	.625	5—8
	9	.140625			41	.640625	
5	10	.15625		21	42	.65625	
	11	.171875			43	.671875	
6	12	.1875	3—16	22	44	.6875	11—16
	13	.203125			45	.703125	
7	14	.21875		23	46	.71875	
	15	.234375			47	.734375	
8	16	.25	1—4	24	48	.75	3—4
	17	.265625			49	.765625	
9	18	.28125		25	50	.78125	
	19	.296875			51	.796875	
10	20	.3125	5—16	26	52	.8125	13—16
	21	.328125			53	.828125	
11	22	.34375		27	54	.84375	
	23	.359375			55	.859375	
12	24	.375	3—8	28	56	.875	7—8
	25	.390625			57	.890625	
13	26	.40625		29	58	.90625	
	27	.421875			59	.921875	
14	28	.4375	7—16	30	60	.9375	15—16
	29	.453125			61	.953125	
15	30	.46875		31	62	.96875	
	31	.484375			63	.984375	
16	32	.5	1—2	32	64	1.	1

STORAGE CAPACITY OF PIPES

To find the effective storage capacity of a main at a given pressure, the figures in the table must be multiplied by the length of main and by the gauge pressure.

Example: 5 inch main, 600 yards, 5 lbs. Table gives 2.78 cubic ft. per 100 yards per lb.

$$2.78 \times \frac{600}{100} \text{ yds.} \times 5 \text{ lbs.} = 83.4 \text{ cu. ft.}$$

of free gas, i. e., gas at atmospheric pressure. This is the storage of available gas, and does not include the dead gas which is left in the main when the gauge is down.

To find the leakage indicated by drop of gauge, the figure in the table must be multiplied by the length of main and by the fall of pressure only.

Example: 5 inch main, 600 yards, gauge drops 6 lbs. to 4 lbs. (fall 2 lbs.) in 5 hours. Table gives 2.78 cubic ft. per 100 yards per lb.

$$2.78 \times \frac{600}{100} \text{ yds.} \times 2 \text{ lbs.} = 33\tfrac{1}{2} \text{ cu. ft.}$$

of free gas lost in 5 hours.

Correction for temperature should be made on the whole quantity of gas in the main (including dead gas) calculated roughly at the mean pressure of the gauge (5 lbs.). This whole quantity is found from the table by adding the figure 40.9 in the column headed "per atmosphere" to the 2.78 per lb. multiplied by 5 lbs.

$$40.9 + 13.9 = 54.8 \text{ cu. ft. per 100 yards.}$$

$$54.8 \times \frac{600}{100} \text{ yds.} = 329 \text{ cu. ft. total content.}$$

The correction for temperature is roughly 1 per cent for every 5° F. in the case of dry gas or 1 per cent for every 4° F. in the case of saturated gas. In dealing with gas in mains 1 per cent for 4° F. can be taken for a fall of temperature, when moisture may be assumed to be thrown down, and 1 per cent for 5° F. for a rise of temperature.

If the temperature has fallen 8° F. during the test in above example, we take 2 per cent of 329 cubic feet capacity = 6½ cubic feet to pressure is 14.7 lbs. above atmosphere (= 2 atmospheres absolute).

STORAGE CAPACITY OF PIPES, AND LEAKAGE IN CUBIC FEET (OF FREE GAS), INDICATED BY DROP OF PRESSURE

Dia. Ins.	Area Square Inches	Cubic feet per atmosphere (14.7 lbs.) per 100 yds.	Cubic feet per lb. (gauge) per 100 yds.	Cubic feet per inch mercury (gauge) per 100 yds.	Cubic feet per inch (water gauge) per 100 yds.	Cubic feet per atmosphere (14.7 lbs.) per mile	Cubic feet per lb. (gauge) per mile	Cubic feet per inch (mercury gauge) per mile	Cubic feet per inch (water gauge) per mile
¾	.442	.92	.063	.031	.0023	16.2	1.10	.54	.04
1	.785	1.64	.111	.055	.0040	28.8	1.96	.96	.07
1¼	1.227	2.56	.174	.085	.0063	45.0	3.06	1.50	.11
1½	1.767	3.68	.250	.123	.009	64.8	4.41	2.16	.16
2	3.142	6.55	.445	.22	.016	115	7.84	3.85	.28
2½	4.908	10.2	.695	.34	.025	180	12.2	6.01	.44
3	7.069	14.7	1.00	.49	.036	259	17.6	8.65	.64
3½	9.621	20.0	1.36	.67	.049	353	24.0	11.8	.87
4	12.57	26.2	1.78	.87	.064	461	31.4	15.4	1.13
5	19.64	40.9	2.78	1.37	.100	720	49.0	24.1	1.77
6	28.27	58.9	4.01	1.97	.145	1037	70.5	34.6	2.55
7	38.48	80.2	5.45	2.68	.20	1411	96.0	47.1	3.47
8	50.27	105	7.12	3.50	.26	1843	125	61.6	4.53
9	63.62	133	9.02	4.43	.33	2333	159	77.9	5.73
10	78.54	164	11.1	5.47	.40	2880	196	96.2	7.07
11	95.03	198	13.5	6.61	.49	3484	237	116	8.56
12	113.1	236	16.0	7.87	.58	4147	282	138	10.2
14	153.9	321	21.8	10.7	.79	5643	384	188	13.9
15	176.7	368	25.0	12.3	.90	6479	441	216	15.9
16	201.1	419	28.5	14.0	1.03	7374	502	246	18.1
18	254.5	530	36.1	17.7	1.30	9332	635	312	22.9
20	314.2	655	44.5	21.9	1.61	11521	784	385	28.3
22	380.1	792	53.9	26.5	1.94	13937	948	465	34.2
24	452.4	942	64.1	31.5	2.31	16588	1128	554	40.7
26	530.7	1106	75.2	36 9	2.72	19459	1324	650	47.8
27	572.6	1193	81.2	39.9	2.93	20995	1428	701	51.6
30	706.9	1473	100.2	49.2	3.62	25920	1763	866	63.7
33	855.3	1782	121.2	59.5	4.38	31361	2133	1047	77.0
36	1017.9	2121	144.3	70.8	5.21	37323	2539	1246	91.7
42	1385.4	2886	196.3	96.4	7.09	50798	3456	1696	125
48	1809.6	3770	256.5	126.0	9.26	66352	4514	2216	163

NOTE—The effective storage capacity of high pressure main (or any fixed vessel) only reaches the cubical contents thereof when the

subtract from the apparent leakage of 33½ cubic feet shown by the gauge. The net leakage is therefore 27 cubic feet of free gas in 5 hours = 5½ cubic feet per hour.

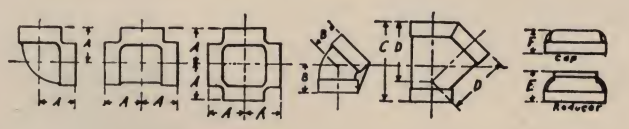
Barometrical correction can be made very simply by adding the rise of the barometer to the final reading of the gauge or deducting the fall, before calculating the leakage from the table. Thus in the above example, if the barometer has risen 0.4 inch mercury, this would equal about 0.2 inch lb. to add to the final gauge reading 4. lbs. = 4.2 lbs. Therefore the fall of the gauge thus corrected becomes $6 - 4.2 = 1.8$ lbs., and the leakage

$$2.78 \times \frac{600}{100} \text{ yds.} \times 1.8 \text{ lbs.} = 30 \text{ cu. ft. (in 5 hours).}$$

This figure remains to be corrected for temperature as previously explained.

In testing leakage by drop of gauge it cannot be too clearly understood that the longer the length of main and the greater its size, the more serious is the loss of gas for a given fall of pressure. Also the greater is the need for meteorological corrections.

APPROXIMATE WEIGHTS AND DIMENSIONS OF STANDARD SCREWED FITTINGS



Size In.	Malleable Iron									
	Dimension in Inches						Weight in lb. per 100 pieces			
	A	B	C	D	E	F	Ells	45-Ells	Tees	Crosses
¼	13/16	¾	.....	.....	1	5/8	13	11	14	.....
⅜	15/16	13/16	.....	.....	1⅛	¾	17	14	23	21
½	1⅛	⅞	2½	1 11/16	1¼	⅞	27	21	35	42
¾	1 5/16	1	2⅞	2	1 7/16	1 1/16	39	32	55	54
1	1 7/16	1⅛	3 7/16	2 7/16	1 11/16	1 3/16	60	50	80	96
1¼	1¾	1 5/16	4 1/16	2 15/16	2 1/16	1¼	105	80	136	152
1½	1 15/16	1 7/16	4½	3 5/16	2 5/16	1 5/16	131	111	183	197
2	2¼	1 11/16	5 7/16	4 1/16	2 13/16	1 7/16	232	197	285	340
2½	2 11/16	1 15/16	6¼	4 11/16	3¼	1⅝	420	350	428	575
3	3⅛	2 3/16	7¼	5 5/16	3 11/16	1¾	637	483	742	960
3½	3 7/16	2⅜	.....	.....	4	1 15/16	940	665	1000	1040
4	3¾	2⅝	8⅞	6 15/16	4⅜	2	1100	775	1200	1550

	Cast Iron									
¼	13/16	¾	.....	.....	.....	.....	14	.....	20	.....
⅜	15/16	13/16	.....	.....	.....	.....	24	24	32	.....
½	1⅛	⅞	2½	1⅞	.....	.....	40	37	53	70
¾	1 5/16	1	3	2¼	.....	.....	55	55	81	100
1	1 7/16	1⅛	3½	2¾	.....	.....	93	84	122	150
1¼	1¾	1 5/16	4¼	3¼	2⅛	.....	152	138	200	238
1½	1 15/16	1 7/16	4⅞	3 5/16	2¼	.....	192	196	268	350
2	2¼	1 11/16	5¾	4½	2 7/16	.....	318	284	430	530
2½	2 11/16	1 15/16	6¼	5 5/16	2 11/16	.....	500	440	650	785
3	3⅛	2 3/16	7⅞	6⅛	2 15/16	.....	700	660	1000	1100
3½	3 7/16	2⅜	8⅞	6⅞	3⅛	.....	920	850	1325	1550
4	3¾	2⅝	9¾	7⅝	3⅜	2 1/16	1250	1125	1780	2150
4½	4 1/16	2 13/16	11⅝	9¼	3⅝	2 3/16	1600	1450	2330	2700
5	4 7/16	3 1/16	11⅝	9¼	3⅞	2⅜	2100	1650	2620	3000
6	5⅛	3 7/16	13 7/16	10¾	4⅜	2⅝	3000	2500	4000	4300
7	5 13/16	3⅞	15¼	12¼	4 13/16	2⅞	4400	3500	5500	6600
8	6½	4¼	16 15/16	13⅝	5¼	3⅛	5500	4600	7900	8300
9	7 3/16	4 11/16	20 1/16	16¾	5 11/16	3⅜	7800	6900	10200	13600
10	7⅞	5 3/16	20 1/16	16¾	6 3/16	3⅝	11100	8600	14900	15400
12	9¼	6	24⅛	19⅝	7⅛	4¼	16800	12500	21500	25500

THE CONNERSVILLE BLOWER COMPANY

Mount St. and Columbia Ave.
CONNERSVILLE, INDIANA

BRANCH SALES OFFICES:
53 W. Jackson Blvd., Chicago 604 Chamber of Commerce, Pittsburgh 114 Liberty St., New York

PRODUCTS.

Meters—Rotary Displacement
For Coke Plant, Station, Sectional Distribution, Large Consumer Installation, Natural Gas.

Boosters—Gas.
For Distribution Systems and Industrial Service

Exhausters—Gas
For By-Product or City Gas Plants.

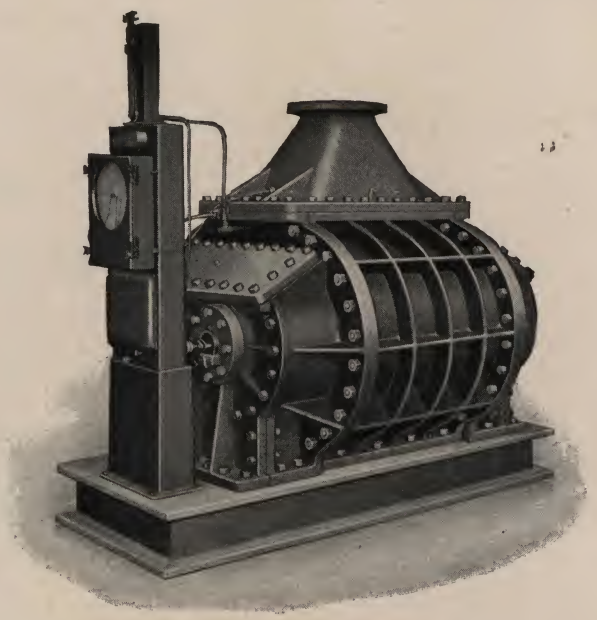
Blowers—Rotary Positive Pressure.
Used for Water Gas Sets, Industrial Furnaces or Revivifying.

Pumps—Cycloidal
For Tar, Wash Oil, Lubricating Oils, Water, or Vacuum Service.

Governors—Gas or Engine.

Regulators—Pressure or Suction.

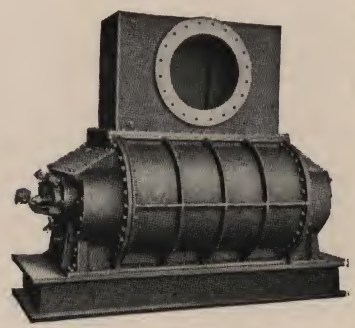
Couplings and other Accessory Equipment.



Connersville High Pressure Meter with P. V. T. T. Recording Gauge

THE CONNERSVILLE METER.

When the Connersville Blower Company designed and offered to the gas industry the Rotary Volumetric Displacement Meter, a new idea of dependable accuracy in gas measurement was established. First installed as a station meter, measuring gas from the purifiers to the holder, the Connersville Meter, with its improved design, is now in service on coke oven gas; on large buying and selling contract installations; on district measurement; on industrial and heating loads; on natural gas lines, etc. The reliability of Connersville Meters has been thoroughly demonstrated.



Connersville Station Meter

Connersville Meters give you these advantages:

1. **Accuracy of Measurement.** The unvarying displacement at each revolution, is accurately calculated and proved. It does not change, since it is bounded by accurately machined cast iron surfaces that cannot be changed by the operator.

2. **Wide Range of Capacity.** The speed of rotation of the impellers will change, permitting the meter to maintain its accuracy over a large fluctuation in gas flow.

3. **Small Installation Cost.** Rotary motion gives large measuring capacity in a small space, economizing in building expense. A single meter will handle large and varying volumes on industrial loads, reducing the cost of complicated headers.

4. **Low Operating Differentials.** Refinement of design and accurate workmanship enables the meter to operate smoothly on low differential pressures. Meter ratings are based on ½" and 1" differential, but at low rates of flow only 1/10" may be needed.

5. **Improved Design** with bearings mounted in easily accessible housings at the ends of the impeller shafts outside the gears, putting these parts out of the zone of gas flow.

High Pressure Meters

Connersville Wide Range Tandem Meter

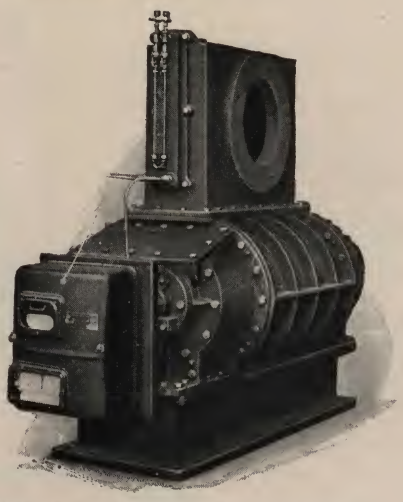
Connersville High Pressure Meters are designed for pressures to 50 lbs. per square inch. The requirements of high pressure distribution and natural gas lines call for special construction, the sturdiness of which can be noticed in the illustration.

The Connersville Wide Range Meter

Where extremes in peaks and low loads must be met the Connersville Tandem Meter gives accurate readings on distribution lines and industrial installations. Ask for Bulletin 4D.

Industrial Meters

In factory, apartment house, restaurant, or other large consumer installations, the Connersville Meter, either in standard or tandem arrangement, is easy to install as there will be only two connections to make instead of many. The same dependable accuracy will be found in these sizes as in the large station meters.



Connersville Meter with Maximum Demand Recorder

Connersville Exhausters

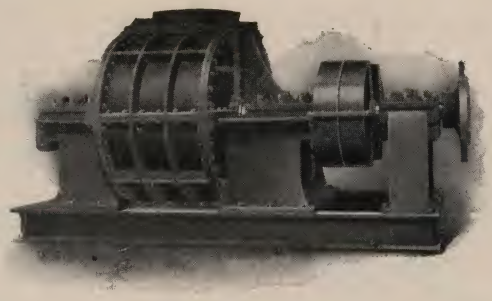
In by-product coke plants, or the city gas plant, Connersville Exhausters are operating steadily and economically. Capacities 3,000 cu. ft. per hour and greater.

Large Double Drive Exhauster

They include the patented stuffing boxes, the quarter box adjustable bearings and other special Connersville features, described in Catalogue No. 22.

Rotary Positive Boosters

For distribution lines or a single industrial consumer—in capacities of 300 cu. ft. per hour or more—maintaining pressures up to 5 lbs. in the smaller sizes and 10 to 12 lbs. in the larger units—the Connersville Rotary Boosters offer an economical means of forcing the gas from city to city, to outlying districts, or keeping the desired pressure at the burner.



Boston Type Booster

Connersville Boosters may be equipped for direct steam or gas engine, or electric motor drive, or with pulleys for belt connection to prime mover.

Motor Driven Tar Pump

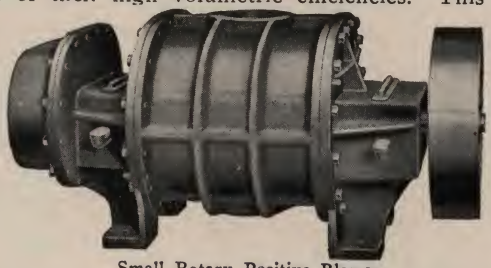
Cycloidal Rotary Pumps

Simple, sturdy design that does not include valves, springs and other small parts, enables Cycloidal Pumps to handle tar, oil and other heavier liquids. The action of these pumps is positive, but the motion is rotary. Used to handle wash oils, benzol, straw oils, ammonia liquor, tars, oily waters, and other liquids of the by-product and city gas plants.

Bulletin 19 lists sizes and gives details of design.

Rotary Positive Blowers

More air per horsepower or K. W. input to motor is possible with Connersville Rotary Positive Blowers because of their high volumetric efficiencies. This combined with their positive pressure characteristic, means more economical operation of the water gas plant. Figures on power consumption and the use of the exhaust steam will be interesting. Ask for them as applied to your plant.



Small Rotary Positive Blower

These blowers, in the smaller Victor sizes, are used to supply the auxiliary air to gas burners and also for revivifying. See Bulletin 121.

Catalogues and Engineering Service

Because of a wide variety of types and sizes in all of these products, it is impractical to list them. Descriptive catalogues and bulletins are available for your use.

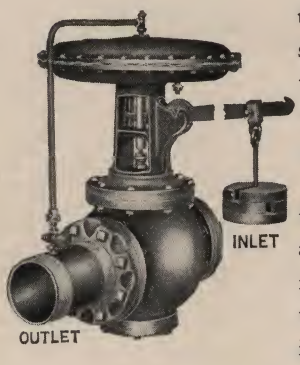
On problems of choice and installation of the various types of equipment, the experience of our Engineering Department is available to assist you. All that is needed is a description of your plant conditions and the work that is to be done.

THE CHAPLIN-FULTON MFG. CO.

28-40 PENN AVENUE, PITTSBURGH, PA.

PRODUCTS: Fulton High Pressure Regulators, Low Pressure Regulators, Duplex Sensitive Governors, Reducing Regulators for Manufactured Gas, Quick-Opening Glass House Regulators, By-Product Coke Oven Gas Regulators, Throttling Regulators for Compressors, Back Pressure Regulators, Compressor Regulators, Vacuum Regulators, Duplex Senitive Vacuum Governors, Vacuum Pump Governors, Duplex Vacuum Relief Valves, House Regulators (weight and lever type), House Service Regulators (spring style), High Pressure Spring Regulators, Weighted Illuminating Regulators, Gas-Fuel Boiler Gove rnors, Gas Relief Valves for Natural Gas Gasoline Plants, Dead Weight Regulators, Differential Gas Relief Valves for use in connection with Orifice Meters, Dashpots or Sensitizers, Dead Weight Safety Valves, Differential Regulator for Mixing Gases, Cut-out Latch Regulator.

FULTON REDUCING REGULATORS

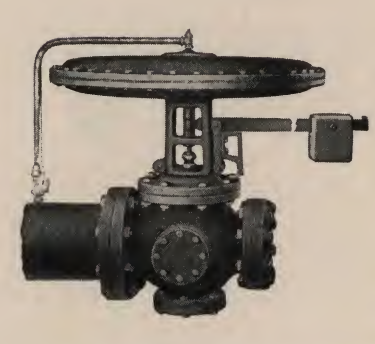


The Fulton Reducing Regulator is used to cut the pressure of compressed gas down to a medium pressure, at the distributing point, where it enters the district governors.

The valves are provided with durable leather seats and all parts constructed with reference to the prevention of tar or other impurities affecting the free movement of the valves.

FULTON LOW PRESSURE REGULATOR

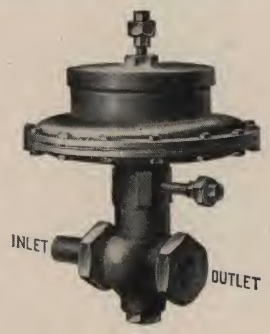
With Automatic Cut-off



The Fulton Low Pressure Regulator may be set to reduce to two ounces, or any pressure above that to one pound. This is easily and instantly accomplished by merely changing the position of the weight on the lever.

The automatic cut-off is attached to all low pressure regulators, without extra cost. It may be used on all sizes of our lever and weight type low pressure regulators where the outlet pressure is one pound or less.

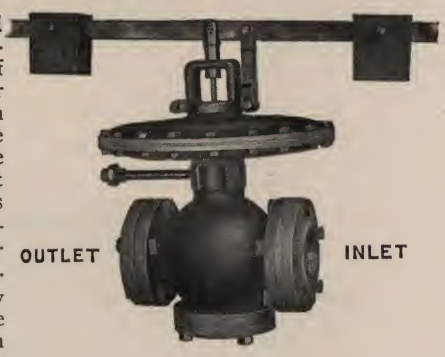
FULTON DEAD WEIGHT REGULATOR



It is designed to reduce a medium pressure of 15 pounds or less to any given delivery pressure between 2 ounces and 6 ounces. It may be used as a district governor, or for individual service.

In this governor the delivery pressure is balanced by a series of weights inclosed in the top of the diaphragm case. It has balanced valves, is practically frictionless, is very sensitive and maintains a perfectly uniform pressure throughout the entire range of flow.

THE FULTON WEIGHTED ILLUMINATING REGULATOR



It is designed to reduce a medium pressure of 15 pounds or less to any given delivery pressure between 1 ounce and 5 pounds. It may be used as a district governor, or for individual service.

It is especially adapted for the reduction of an extremely low inlet pressure. It is also recommended for use where the difference between inlet and outlet pressure is very slight.

It has balanced valves, is practically frictionless, very sensitive, and will maintain a perfectly uniform pressure throughout the entire range of flow.

REGULATORS FOR EVERY CF PRESSURE AND SERVICE

FULTON UNLOADER OR THROTTLING REGULATOR

The Fulton Throttling Regulator is designed to maintain a constant pressure at the discharge of an air or gas compressor under varying conditions of load. The regulator is placed in the suction line to the compressor and is controlled by the pressure at the discharge.

The diaphragm is connected to the discharge line and the pressure in this line acting on the diaphragm surface is balanced by weight on the lever.

A tendency of the discharge pressure to rise overbalances the weight on the lever and the valve moves toward its seat, throttling the suction sufficiently to restore and maintain the discharge pressure at a fixed point.

FULTON HOUSE SERVICE REGULATORS SPRING TYPE

The valve is opened by a spring instead of the lever and weight.

The valve has a renewable seat. Both valve and seat can be easily taken out and replaced without taking the entire regulator apart.

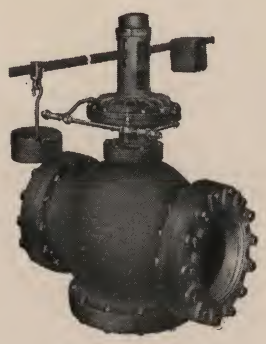
Will reduce any intake pressure up to 100 pounds to a delivery pressure of a few ounces.

FULTON BACK OR CHECK PRESSURE REGULATOR

Used to stop the flow of gas in a pipe line when the pressure in the same falls to a given point, or to stop the flow of gas in a line or system of gas lines when the pressure has fallen to a lower point than is considered advisable. Also, if necessary to keep the pressure higher in one portion of a system of distributing lines that are so connected that the gas flows from one to the other, or where a gas well is discharging gas into the suction line of a pump, it is desirable that the pressure in the well, or line leading therefrom, should be kept above atmospheric pressure, or that the flow of gas from the well should not be drawn below a certain given figure.

FULTON DIFFERENTIAL REGULATOR

For Mixing Gases

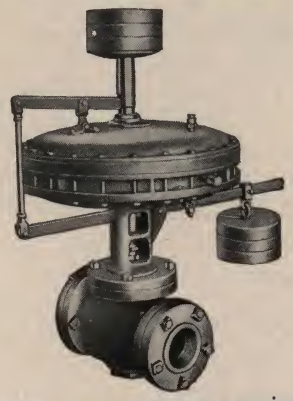


For maintaining the pressure ratio or differential between natural and manufactured gas for a definite heating value.

Among the many other uses it may be used as a check valve in a line to a gas holder or in a pipe line of considerable length in which breaks may occur, to prevent the escape of the large volume of gas present in the line.

It may also be used to maintain a constant rate of flow. When used as a constant volume control, a pressure reducing regulator is placed on the inlet side, and an orifice on the outlet side of the Differential Regulator.

DUPLEX SENSITIVE GAS GOVERNORS, FOR MANUFACTURED OR NATURAL GAS

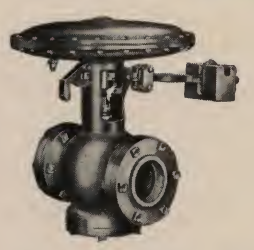


Will control a high varying inlet pressure and reduce this to a low and unvarying outlet pressure, for illuminating or fuel purposes.

Materials used in its construction are resistant to the chemical action of all manufactured gases; all frictional surfaces are eliminated, and the diaphragm surface is increased by the use of two diaphragms, thus giving it vastly greater sensitiveness and power over governors equipped with but one diaphragm.

FULTON CUT-OUT LATCH REGULATOR

Rolling Weight Type



The purpose of this regulator is to stop the flow of gas through the body when the pressure on the diaphragm falls to a given point. It is provided with a cut-out latch, which automatically holds the valve to its seat, when the pressure on the diaphragm fails.

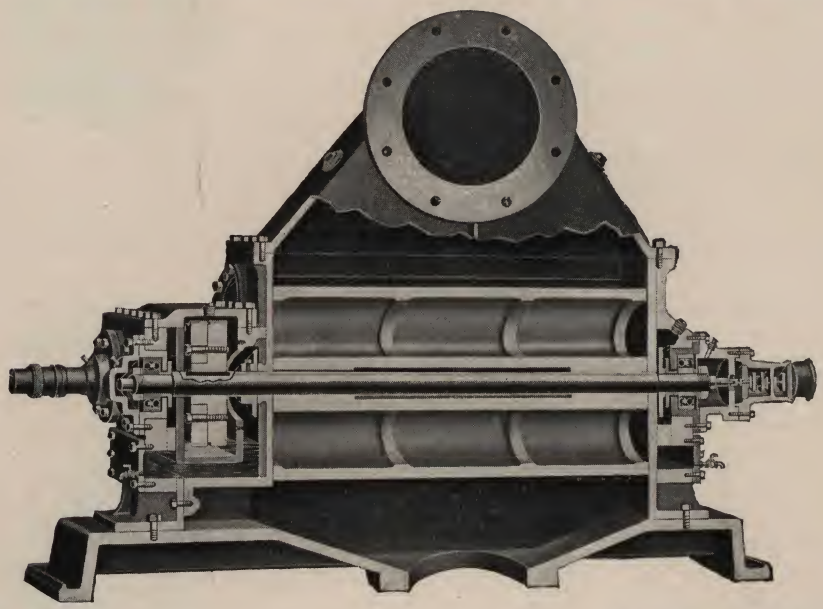
It is used principally in connection with low pressure burners and furnaces where it is desirous to protect the equipment against hazards due to failure of the gas supply. Should such a condition exist or the gas pressure drop below a predetermined point, the function of this regulator is to shut off, immediately, the supply of gas to the burners, and at the same time lock the valve in such a manner that the gas cannot be turned on at the burners without the operator going to the valve and opening it by hand.

THE P. H. & F. M. ROOTS CO.

107 Water Street
CONNERSVILLE, INDIANA

Chicago
432 Peoples Gas Bldg.

New York
120 Liberty Street



ROOTS METER Model SA:

When you are interested in metering equipment, we respectfully ask that you study carefully the design and mechanical construction of the ROOTS METER, Model SA, from the standpoint of an operating engineer.

We are confident that you will be favorably impressed, not only by the mechanical features, but also by the desirability of the unit as a piece of service equipment for your own plant. When shipped from our factory this meter is a refined, accurate measuring instrument, and the design is such that it may be so maintained indefinitely.

PRODUCTS:

Meters	**Vacuum Pumps**
Gas Pumps	**Flexible Couplings**
Blowers	**Gates & Valves**
Liquid Pumps	**Speed Governors**

(*Bulletins are available on all products.*)

ROOTS METERS:

Capacities of standard sizes of Roots Meters, Model SA, range from very low limits to 1,000,000 cubic feet per hour. Line pressures of 100 pounds are permissible. Extra large shafts eliminate vibration and permit use of extra large bearings. All operating parts are totally enclosed in gas-tight housings. Roots Proportional Metering Unit is ideal for properly regulating gas mixtures. Extreme accuracy, negligible maintenance cost, small size, double adjustable timing gears, direct-volume reading, low first cost, simplicity and Roots reliability combine to form a standard of metering perfection exclusively Roots'.

ROOTS GAS PUMPS:

Roots Gas Pumps (Boosters, Exhausters) are for handling gas at pressures up to 10 pounds in any desired capacity.

Roots Acme Gas Pumps are for the smaller capacities, with pressure ranges up to 6 or 8 pounds.

Long life, dependable service, high efficiency, positive delivery and power requirements in direct proportion to work performed are distinctive Roots characteristics.

ROOTS BLOWERS (Water-Gas):

Roots Roller-Bearing Blowers deliver positively desired quantities of air at pressures up to 10 pounds. Various styles of drive, including gear and pinion, flexible coupling, silent chain, belt and pulley and tex-rope, may be applied with any practical source of power. Closer clearances, higher speeds, more capacity with less horsepower and lower operating costs are all features of the Roots Roller-Bearing Blowers.

Roots Acme Blowers are for small capacities and pressures up to 6 or 8 pounds and are built with roller bearings.

ROOTS LIQUID PUMPS:

These pumps handle any substance not containing grit with a range in economy of 75% to 90%, depending upon operating conditions. Special linings and impellers can be furnished for handling corrosive liquids. Sizes range from large pumps handling 50,000 gallons at 70 r.p.m., to the smallest pump of 0.06 gallon displacement per revolution at 750 r.p.m. Operating range is from 10 to 200 foot head.

ROOTS VACUUM PUMPS:

For large volumes over wide vacuum range. Roots Vacuum Pumps handle wet or dry vacuum ranging up to 27". Used with heating systems, vacuum filtration, priming centrifugal pumps, etc. Extremely heavy shafts, rugged self-oiling bearings, oil-tight and dust-proof gear housings, and sturdy construction throughout explain superiority and popularity of these pumps. Use one for handling air, gases or vapors, either alone or simultaneously with liquid.

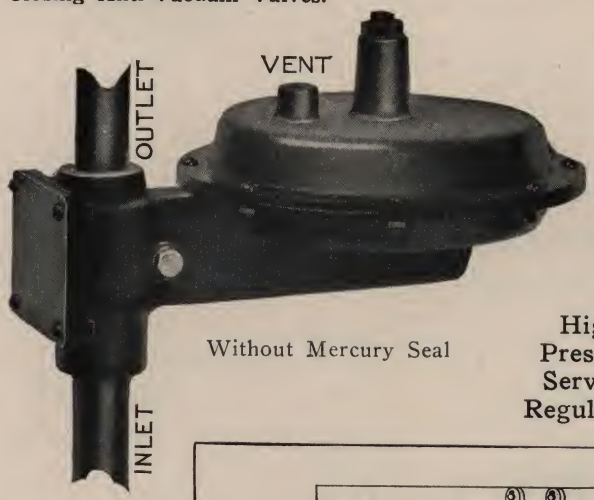
GROBLE
REGULATORS & GOVERNORS

GROBLE GAS REGULATOR COMPANY

GENERAL OFFICES
ANDERSON, INDIANA

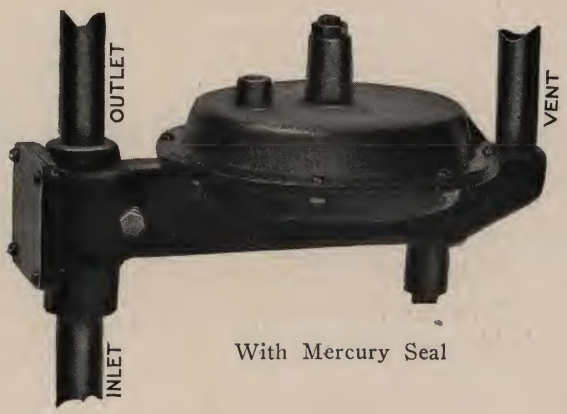
PRODUCTS:

High Pressure Service Regulators, Intermediate Pressure Service Regulators, Low Pressure Service Regulators, High Pressure Line Regulators, Single District Station Regulators with Secondary Governors and Master Bowl control, Single District Station Regulators with Master Bowl control only, Single District Station Regulators that automatically increase and decrease the outlet pressure according to demand, Differential Regulators, Proportional Mixing Regulators; Intermediate Pressure Governors, Holder Governors, Triple Outlet Governors, Automatic Governors for between Holder and High Pressure Mains; Relief Valves, Back Pressure Valves, Automatic Quick Closing Anti-Vacuum Valves.



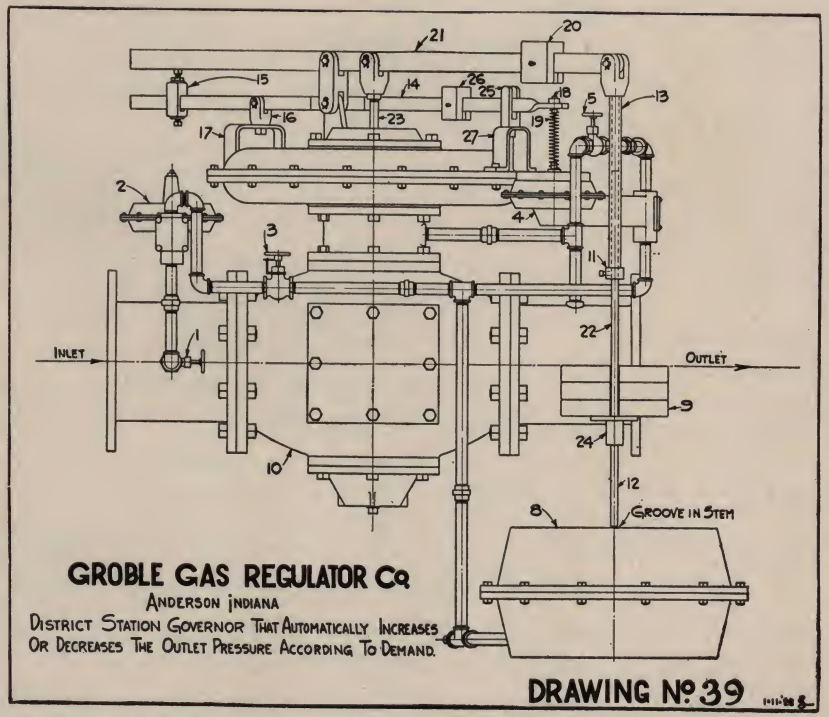
Without Mercury Seal

High Pressure Service Regulators



With Mercury Seal

Our Engineering Staff under the supervision of J. C. Groble at your service. Let this department, supported by 34 years' practical experience in the gas and gas regulator business, assist you with your pressure reductions.



AUTOMATIC DISTRICT STATION REGULATOR

That automatically increases and decreases the Outlet Pressure according to demand.

AMERICAN METER COMPANY

INCORPORATED

Established 1836

The World's Largest Manufacturers of Gas Meters and Allied Apparatus

General Offices: 105 West 40th Street, New York City

FACTORIES AND TRADE NAMES

AMERICAN METER COMPANY,
47th St. and 11th Ave., New York, N. Y.

AMERICAN METER COMPANY,
Peoples Gas Building, Chicago, Ill.

HELME & McILHENNY,
17th and Clearfield Sts., Philadelphia, Pa.

JOHN J. GRIFFIN & CO.,
1513 Race St., Philadelphia, Pa.

MARYLAND METER WORKS,
Holliday and Saratoga Sts., Baltimore, Md.

D. McDONALD & CO.,
991 Broadway, Albany, N. Y.

METRIC METAL WORKS,
Erie, Pa.

PACIFIC METER WORKS,
495 Eleventh St., San Francisco, Cal.
2118 Atlantic St., Los Angeles, Cal.

NATHANIEL TUFTS METER WORKS,
455 Commercial St., Boston, 16, Mass.

Agency and Warehouse

AMERICAN METER COMPANY,
216 Dwight Building, Kansas City, Mo.

GENERAL PRODUCT LIST

APPARATUS—LABORATORY AND EXPERIMENTAL

Calorimeter, American.
Cubic Foot Bottles.
Gasometers.
Gassing Machines.
Gauges, New Improved American Siphon.
Gauges, Standard Siphon or U.
Gauges, Superintendent's Pocket.
Governors, Double Dry.
Governors, Laboratory Dry.
Governors, Presure.
Governors, Wet Calorimeter.
Hydrogen Sulphide Test, Chimney Type
Hydrogen Sulphide Test, Youngs
Meter Provers.
Meter Testers, Hydro-Pneumatic.
Meters, Wet Test 1-20 cu. ft.
Meters, Wet Test 1-10 cu. ft.
Meters, Wet Test Large Capacity 5-80 to 100-1200 cut ft.
Specific Gravity Apparatus, Bureau of Standards.
Specific Gravity Apparatus, Schilling.
Stop Clock.
Stop Watch
Sulphur and Ammonia Test, Referees'.
Thermometers, Calorimeter.
Thermometers, Condenser.
Thermometers, Meter Prover.
Thermometers, Wet Test Meter.

APPARATUS, SERVICE

Filters, Denver Gas.
Filters, R. G. T.
Furnaces, Gas Soldering.
Gauges (See Apparatus Laboratory).
Meters, Critical Flow Orifice Prover for H. P. Field Testing.
Meters, Portable Test 20 cu. ft.
Meters, Portable Test 85 cu. ft.
Meters, Portable Test 5 and 10 Lt.
Providence Vacuum Tank (Service Cleaner).
Pumps, Drip.
Service Cleaner—New American.
Thermometers (See Apparatus Laboratory).

METER DEMAND DEVICES

Empire Demand Limiting.
Indicating Demand.
Maryland Demand.
Recording Demand.

METER MAINTENANCE AND ACCESSORIES

Meter Connections.
Meter Diaphragms.
Meter Repair Parts.
Meter Consumers, Use and Care of.

METERS—DEMONSTRATION

Index, Demonstrating.
Meters, Glazed Exhibition.
Meters, Iron Case Observation.
Meters, Large Dial Demonstration.
Meters, wth Registering Index.

AMERICAN METER COMPANY

INCORPORATED

Established 1836

The World's Largest Manufacturers of Gas Meters and Allied Apparatus

General Offices: 105 West 40th Street, New York City

METERS—DOMESTIC AND INDUSTRIAL SERVICE

Meters, A Type (Tinned Steel Case).
Meters, B Type (Tinned Steel Case).
Meters, C Type (Tinned Steel Case).
Meters, Prepayment (Tinned Steel Case).
Meters, Iron Case (Low, Medium and High Pressures).
Meters, Iron Case Prepayment.

METERS—LARGE VOLUME MEASUREMENT

Meters, Linderman Orifice.
Meters, Westcott Orifice.
Meters, Wet Station.

SERVICE CLEANERS

Providence Vacuum Tank.
Pumps, Drip.
New American Service Cleaner.

PUBLICATIONS OF AMERICAN METER COMPANY

The following publications are distributed gratis.

General Catalogue G-1 1929.
Laboratory Bulletin E-1, Descriptive of Erie Laboratory.
Orifice Meter Bulletin No. 123.
Apparatus Bulletins.
Calimetry Bulletin.
(Furnished with each American Calorimeter.)
Instructions for the Proving and Testing of Meters.
(English and Spanish Including Percentage of Error Tables.)
Gas Measurement Engineering.
(Periodic Information Bulletin of American Meter Company products and activities.)

The following publications are available from Metric Metal Works, prices net, cash with order.

Natural Gas Handbook	$5.00 and $6.50
Handbook of Casinghead Gas	3.75 and 4.50
Pressure Extension Book	12.50
Pressure Extension Book Abbreviated	2.50
Measurement of Gases and Liquids by Orifice Meter	3.75 and 4.00
Measurement of Gases where Density Changes	1.00

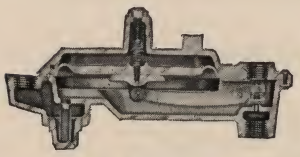
Please see also the current advertising pages in the Gas Trade Journals for Product News and Announcements.

REYNOLDS GAS REGULATOR CO.

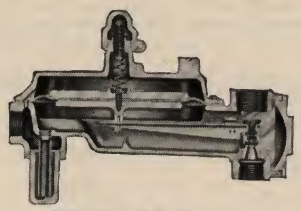
MAIN OFFICE AND FACTORY—ANDERSON, INDIANA.

REPRESENTATIVES: Eastern Service Co., Boston, Mass.—F. E. Newberry, Avon, N. J.
Thos. C. Corin, Detroit, Mich.

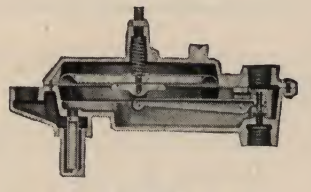
THREE SERVICE REGULATORS *That Answer Every Need*



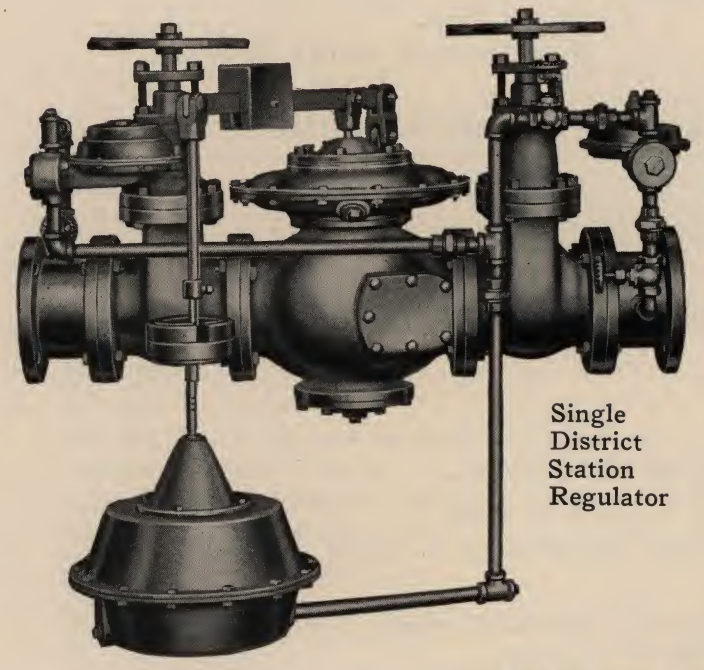
Model 0 Series
With or Without Mercury Seal in Spring Type Regulators



Model 10 Series
With or Without Mercury Seal—Dead Weight or Spring Type



Model 20 Series
With or Without Mercury Seal—Dead Weight or Spring Type



Single District Station Regulator

Reynolds Products

for all kind of Pressure Reduction—for either Artificial or Natural Gas

Governors—

- Intermediate Pressure
- Triple Outlet
- Holder
- Toggle Type Street

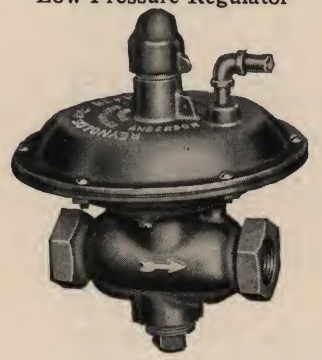
Regulators—

- High Pressure Service
- Low Pressure Service
- Intermediate Pressure
- High Pressure Line
- Single and Double District Station

Valves—

- Automatic Quick-Closing Anti-Vacuum Relief Valves

Accurate Low Pressure Regulator



High Pressure Regulator

Low Pressure Gas Refrigeration Regulator

COMPANY MEMBER OF AMERICAN GAS ASSOCIATION INCORPORATED

RECOGNIZED LEADERSHIP IN GAS CONTROL SINCE 1892

THE SPRAGUE METER CO.

BRIDGEPORT, CONN.

Los Angeles, Calif. Davenport, Iowa Newark, Ohio Houston, Texas San Francisco, Cal.

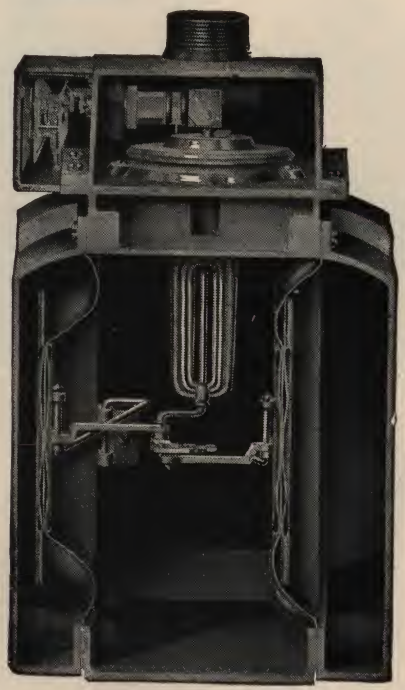
We manufacture two types of consumers' cast iron gas meters.

Our standard line with three measuring chambers, and the oscillating slide valve.

Our Dreadnaught line with four measuring chambers and the Glover type slide valve.

Standard Line.

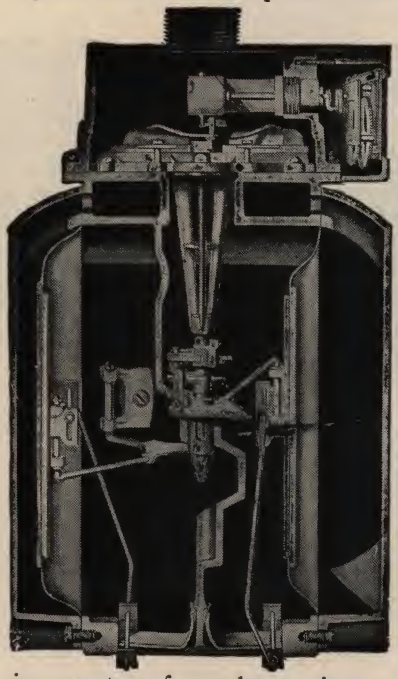
Well-known through over 25 years' service in all parts of the world.



For detail, write for Bulletin No. 10.

Dreadnaught Line.

First made in 1915. This meter has developed into the slowest speed and highest power cast iron meter of equal capacity on the market. Write for Bulletin No. 8.

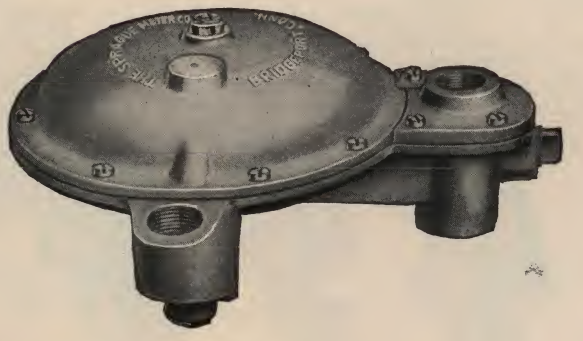


Service Regulators:

Service regulators with seal for high pressures.

Regulators without seal for medium and low pressures.

Write for Bulletin No. 11



BIG SIX METERS FOR INDUSTRIAL INSTALLATIONS

BARCO MANUFACTURING COMPANY

1801 WINNEMAC AVENUE, CHICAGO, ILL.,

AGENTS

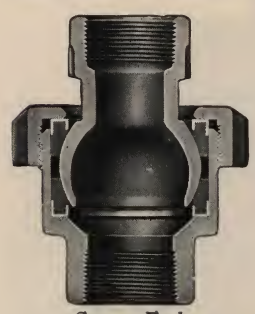
Vinson-Canter Co., Tulsa, Okla.
Steam Supply & Rubber Co., Seattle, Wash.
Greene Bros., Wichita Falls, Texas
Herbert Wolcott, El Paso, Texas
M. N. Dannenbaum Co., Houston, Texas
The Holden Co., Limited, Canada
The Machinery Corp., S. A. Mexico, D. F.
Mr. G. E. Knight, Havana, Cuba

PRODUCTS:

Flexible Ball Joints Lubricated Plug Valves

BARCO FLEXIBLE BALL JOINTS

Barco Flexible Ball Joints are used for oil, gas, steam, air, gasoline, tar, water and other fluids where flexibility is required in a pipe line. Barco Joints are also used to take care of expansion and contraction in pipe lines, and to prevent breaks and leakage from vibration. The first cost of Barco Joints is not excessive and the cost of maintenance is almost negligible.



Screw Ends

Flange Ends

Barco Joints with screw ends are furnished in sizes ranging from ¼ in. to 6 in. They are also made with flanged ends, faced and drilled, or faced only, in sizes from 4 in. to 48 in. inclusive.

Malleable iron is standard in sizes from ¼ in. to 3 in. inclusive; bronze ¼ in. to 2 in. inclusive; semi-steel in sizes from 4 in. to 48 in. inclusive. Barco standard joints are recommended for 200 lbs. steam pressure for sizes up to and including 3 in. whether made of bronze or malleable iron. The standard semi-steel sizes, 4 in., 5 in. and 6 in. are made for 125 lbs. steam pressure.

Barco Joints of all sizes can be made of special materials for special purposes, such as for acid service. Also, they are made extra heavy for high pressures. The 7-8 and 7A8 extra heavy malleable iron joints in sizes ½ in. to 6 in. are suitable for 350 lbs. steam pressure. Barco Gaskets are long-lived—usually wearing for years without attention.

Barco Joints are particularly valuable in relieving strains in oils and gas-pipe lines.

Prices quoted, blue prints or special information or designs furnished on request. Give full details of your problem.

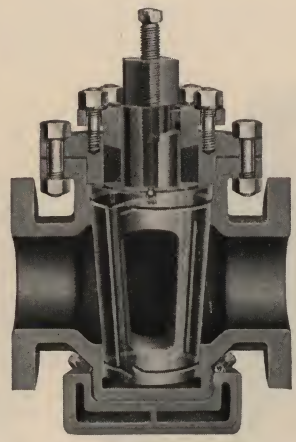
7A-8

7A-8B

7-8B

BARCO LUBRICATED PLUG VALVES

Barco Lubricated Plug Valves supply all of the greatly desired advantages of full direct port opening with a one-quarter turn of the handle. They are suitable for the full range of pressures, temperatures and vacuums that the finest metals will stand.



With Steam Jacket

Screw End

Barco Plug Valves are made in the straight-way, screwed and flanged ends, and in the 3-way and 4-way types. Special materials are used for work with acids, alkalis, etc. Steam jackets are furnished for handling hot tar, asphalt, etc.

Barco Lubricated Plug Valves are easily and positively lubricated without the use of excessive lubrication, since the grease is used only to lubricate the valve and provide ease of operation. Workmanship on these valves insures tightness without aid of the lubricant.

Special Barco Lubricants are furnished for the various services. These lubricants are the finest obtainable.

In the larger sizes, Barco Lubricated Plug Valves are furnished with geared operating handles and locking devices for Barco Valves can be supplied when desired.

3-Way Valve

Flange End Valve With Geared Handle

4-Way Valve

PITTSBURGH EQUITABLE METER COMPANY

PITTSBURGH, PA.

New York, 50 Church Street
Chicago, Peoples Gas Building
Dallas, Republic Bank Building
Los Angeles, Union Bank Building

Branch Offices and Warehouse Stocks

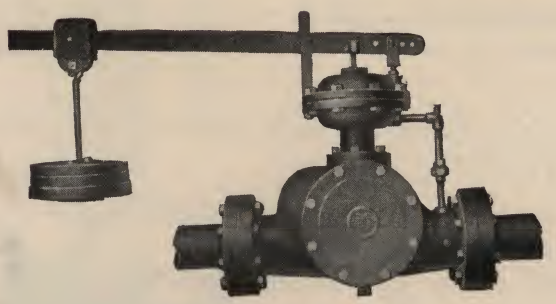
Kansas City, Mutual Building

Tulsa, Kennedy Building
Seattle, 1518 First Avenue South
Columbia, 1433 Main Street
Salt Lake City, 331 Rio Grande Avenue

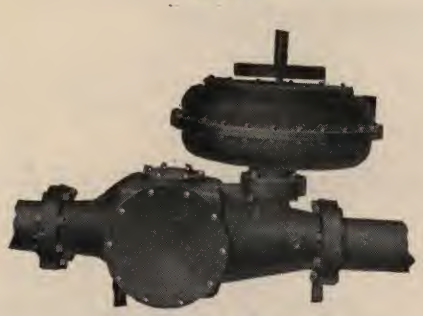
EMCO Tin Meter

EMCO No. 0
Cast Iron Dry Gas Meter

Ironclad Cast Iron Dry
Gas Meter



EMCO High Pressure
Balanced Valve Regulator



EMCO Low Pressure
Balanced Valve Regulator

EMCO No. 5 Pressed Steel Type
Large Capacity Dry Gas Meter

EMCO No. 4 Large Capacity
Meter with EMCO Combined
Record Gauge

Westinghouse Positive Gas Meter

METERS AND REGULATORS FOR EVERY KIND OF SERVICE

SAFETY GAS MAIN STOPPER CO.

Pacific Coast Representative
C. B. Babcock Co., San Francisco, Calif.

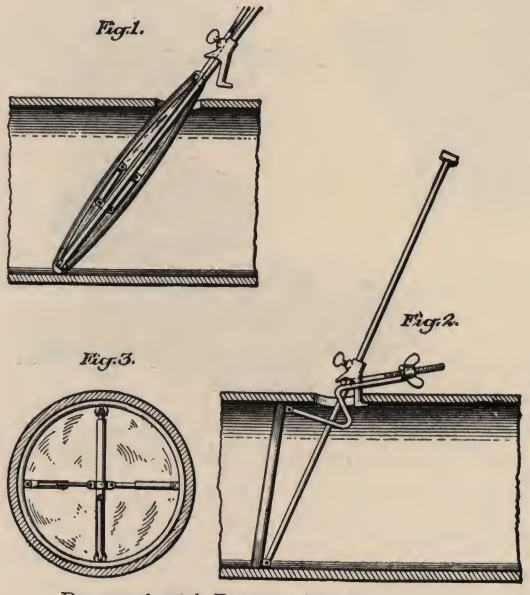
523 Atlantic Avenue
BROOKLYN, N. Y.
Cable Address—Gastopper, N. Y.

New England Representative
Eastern Service Co., Boston, Mass.

STREET DEPARTMENT SUPPLIES—PIPE GANG TOOLS

Goodman Stoppers
Goodman Cylindrical Stoppers
Gas Main Bags
Canvas-covered Bags
Inflating Bulbs
Pumps
Respirators
Service Cleaners "Abbirko"
Joint Runners
Calking Tools
Mittens and Gloves
Rubber Boots
Service Plugs, Rubber
Gas Main Plugs
Soft Wood Plugs
Pipe Cleaning Brushes
Soap Tape
Pressure Gauges, portable and stationary
Packings
AIR-LINE MASKS

GOODMAN *IMPROVED* GAS MAIN STOPPER



Patented and Patents Pending

Used Since 1897

With improvements added from time to time, now has as its newest feature the "Z" Handle for easier manipulation.

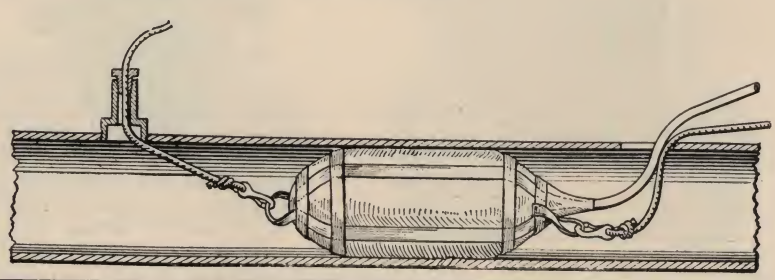
The Locking Sleeve (shown in detail at right) holds the Stopper firmly in place.

The new patented cross bar which backs up diaphragm and prevents "bellying" can be used on sizes from 10" upward.

LOOK FOR THE NAME
"GOODMAN"

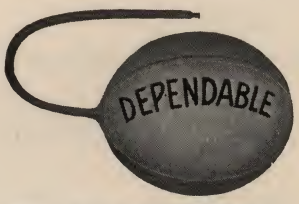
GOODMAN CYLINDRICAL STOPPER

For gas and oil lines, intermediate pressures. This stopper is pulled into place by cables.



1897—Established 32 years—1929

DEPENDABLE GAS MAIN BAGS



Two Types Plain Rubber

TYPE "A"

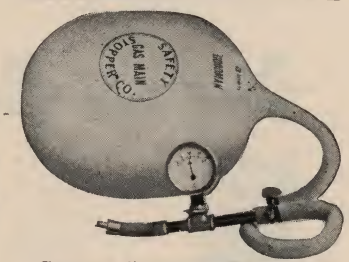
Invisible seam. Light, pliable material, easily inflated 2″ to 24″.

TYPE "B"

Reinforced seams, heavier and stronger than Type "A." Carried in stock 2″ to 48″.

TYPE "C"

For use wherever a plain rubber bag will not hold.
The canvas is treated to resist oil and this bag is used in oil lines while welding is being done.



Canvas Covered—Type "C"

S. G. M. S. GAS BAG PUMP

For inflating bags quickly. Made in cylinder sizes 2″x14″, 2½″x14″, 3″x14″, 4″x14″. The cut shown here is of the 2″x14″ size and the specifications are as follows:

Cylinder—2″x14″.
Capacity—42 cu. ins.
Pressure—15 lbs.
Cylinder of 15 gauge Seamless Brass.

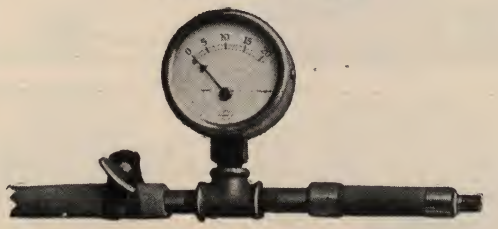
Cap and Base, Bronze.
Furnished with 5 feet of ¼″ hose with tire valve connection, or with standard pipe thread connection.

ABBIRKO HIGH PRESSURE PUMP

(Two Stage)
Fitted with Instantaneous Piston Release Cock and 300 lb. Pressure Gauge.

SENT ON TRIAL

GAS BAG VALVE AND GAUGE



This valve keeps the air in while bag is in use. Pull it out and the bag quickly deflates.
The gauge shows accurate internal pressure in bag, which will prove a safeguard against over-inflation.

AIR LINE MASK

Mask and Blower in Separate Carrying Cases

Blower will supply sufficient air for four masks.

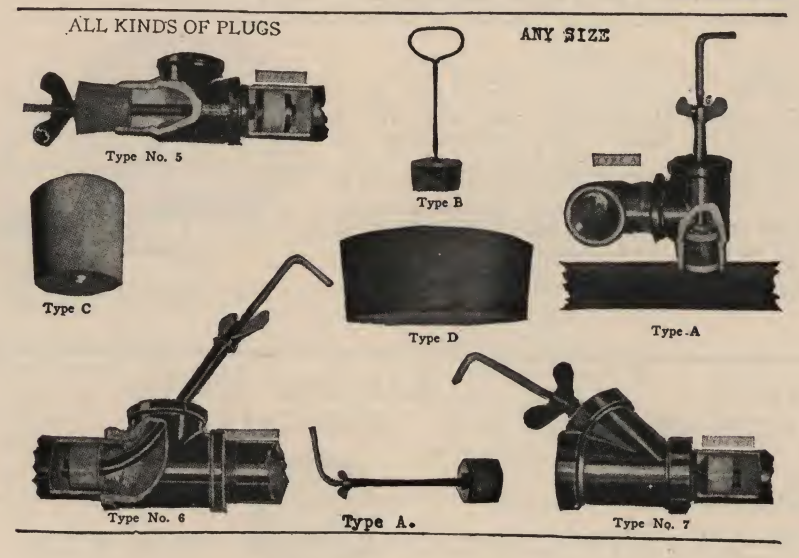
IMPROVED PULSOMAN CHEMICAL CARTRIDGE RESPIRATOR

Reg. U. S. Pat. Off.

Protects against fumes, mist, solids when spraying.

Chemical Cartridge cleans all incoming air you breathe and protects the nose, mouth, lungs and throat.

PLUGS—MANY TYPES FOR MANY USES



Expansion Plugs—¾" to 12".

Soft Wood Plugs—2" to 48".

Rubber Plugs—¾" to 3".

TYPE A—¾" to 12"

TYPE B—¾" to 4"

TYPE C—4" to 8"

TYPE D—8" to 48"

TYPE No. 5—¾" to 3"

TYPE No. 6—¾" to 6"

TYPE No. 7—¾" to 6"

HIGH PRESSURE PLUGS

These plugs are made to withstand pressures up to 125 lbs. in steel and cast iron mains and are made to fit hub ends or cut and spigot ends of pipes. When ordering specify kind of pipe. Cut on left is No. 19 plug—on right No. 21 plug.

SOAP TAPE

Safety Gas Main Soap Tape for bandaging broken pipe. Also Binding Tape to cover soap tape bandage.

PIPE CLEANING BRUSHES

MADERITE RUBBER MITTENS

ASBESTOS JOINT RUNNERS
Solid woven Asbestos Rope
10 sizes, 4" to 48".

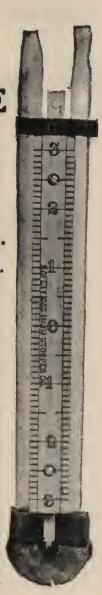
S. G. M. S.
"U" GAUGE
PORTABLE AND STATIONARY READINGS

Portable, up to 24 in.
Stationary, up to 48 in.

CONSTRUCTION

Glass Tubes are firmly seated in rubber fittings

A Durable and Serviceable Gauge Tube can be replaced in five minutes



CRANE CO.

GENERAL OFFICES: CRANE BUILDING
836 SOUTH MICHIGAN AVENUE, CHICAGO

NATIONAL EXHIBIT ROOMS: Chicago, New York, Atlantic City, San Francisco

WORKS: Chicago, Bridgeport, Birmingham, Chattanooga, Trenton

BRANCH HOUSES:

Aberdeen, S. D.
Aberdeen, Wash.
Albany
Albuquerque
Asheville
Atlanta
Atlantic City
Aurora
Baltimore
Beaumont
Billings
Birmingham
Boston
Bridgeport
Brooklyn
Buffalo
Camden
Canton
Casper
Cedar Rapids
Charleston
Charlotte
Chattanooga
Chicago
Cicero
Cincinnati
Cleveland
Columbus
Corpus Christi
Dallas
Davenport
Denver
Des Moines
Detroit
Duluth
East Chicago
El Paso
Evanston
Evansville
Fargo
Ft. Smith
Grand Island
Grand Junction
Grand Rapids
Great Falls
Greensboro
Greenville
Harlingen
Hartford
Hollywood
Houston
Indianapolis
Jacksonville
Jersey City
Joliet
Kansas City
Knoxville
Lexington
Lima
Little Rock
Long Beach
Los Angeles
Macon
Madison
Mankato
Mason City
Memphis
Miami
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New Orleans
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New York
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Oklahoma City
Omaha
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Portland, Ore.
Providence
Pueblo
Reading
Reno
Richmond
Rochester
Rockford
Sacramento
Salt Lake City
San Antonio
San Bernardino
San Diego
San Francisco
Santa Ana
Santa Barbara
Savannah
Seattle
Shreveport
Sioux City
Sioux Falls
South Bend
Spokane
Springfield, Ill.
Springfield, Mass.
Springfield, Mo.
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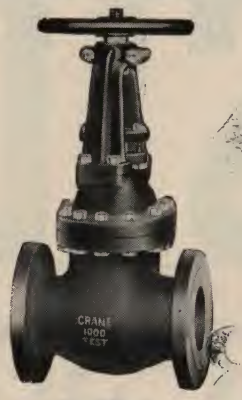
PRODUCTS

Every type and size of valve and fitting used in the gas industry is supplied by Crane Co. The complete Crane line includes more than 30,000 articles, meeting all requirements for piping systems of every description. Catalogs describing the various groups of Crane materials will be mailed on request.

DOUBLE DISC GATE VALVE

Made of Crane Ferrosteel, which is 50 per cent stronger than gray cast iron, the body metal of Double Disc Gate Valve 343 E is dense, with a close-grain structure that is particularly effective for gases and high pressure steam. The discs are accurately guided in the body; inside wedging mechanism is brass-to-iron, with the wedging surfaces machined to reduce friction. Recommended where pressure does not exceed 500 lbs. Supplied with either screwed or flanged ends, in outside screw and yoke pattern, or non-rising stem pattern. For complete specifications refer to Crane Z, sheet 2071-A.



No. 343 E

No. 488

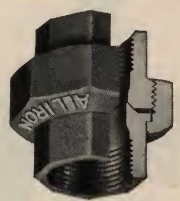
ALL IRON CLAMP GATE VALVE

An inexpensive and serviceable valve, simple in construction, compact, durable. The steel "clamp" which extends around the body of the valve and holds the bonnet securely in place may be easily removed, allowing easy cleaning and repairing of the interior. Meets standard requirements on low pressure lines. Detailed data in Crane Z, sheet 2067-D.

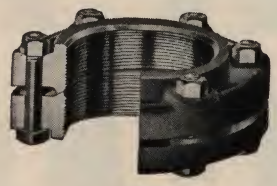
No. 48 Angle

LOCK AND SHIELD VALVES

The Angle Lock and Shield Valve is illustrated; Globe can be furnished. Brass, with a brass disc, ground for gas service. Or made to order with a fibre disc. Packed ready to use. Sizes and prices shown on page 12, Catalog No. 51.



No. 98½ E



No. 773

UNIONS

No. 98½ E is an extra heavy all-iron union with octagon ends. The tight joint obtained by grinding-in the seats, eliminates the need for a gasket. See page 333, Catalog No. 51.

For use in connection with standard malleable fittings, ground joint All-Iron Malleable Flange Union No. 773 is recommended. Full specifications in Crane Z, sheet 2093.

No. 590 Malleable Iron Union Elbow with a brass-to-iron ground seat is one of a complete line of union tees, ells and 45° ells. All are readily taken apart, have ground joints and require no gaskets. These union fittings make it possible to save much thread cutting and to eliminate many joints in piping installations. For specifications see Crane Z sheet, page 42.

No. 590 Elbow with Female Union

No. 595 with Female Union

No. 595 is a Reducing Union of malleable iron, brass-to-iron seat, ground joint, no gasket. All Crane Union tees, ells and 45° ells with brass-to-iron seat have been examined and tested by the Underwriters' Laboratories and listed by the consulting engineers of the National Board of Fire Underwriters. Complete data on page 335, Catalog No. 51.

No. 760 Elbow

No. 760-D

FITTINGS

No. 760 is one of a group of malleable iron fittings, heavier than the ordinary commercial malleable fittings. Long thread lengths and heavy bands. Withstand greater pipe strains than cast iron fittings. See Crane Z sheet 2053-D.

No. 760-D is one of the group of Crane Cast Steel Fittings, having the same center-to-end dimensions as the heavy malleable. Extra-strong, rugged, long thread lengths. Detailed information in Crane Z sheet 2077-C.

KITSON COMPANY

District Representatives—Baltimore, Chicago, St. Louis, Boston, Cincinnati, Cleveland, Detroit, Pittsburgh, San Francisco

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KITSON GAS STOPS

BUILT FOR SERVICE

What are your requirements? Extensive or limited—simple or difficult—we can meet them to the letter. Let us give you an estimate on them.

Compare quality as carefully as you compare price.

GAS STOPS

Manufactured in five weights

"SPECIAL" G-101 and G-115
"STANDARD" Style G-200, etc.

"EXTRA" Style G-300, etc.

"HEAVY SERVICE" Style G-400, etc.

and

"IRON BODY" Brass Plug Style G-500, etc.

LOCKWING IRON-BODY GAS COCK WITH BRASS KEY—BRASS NUT and WASHER

Furnished With or Without Lock Wing Attachment

Kitson Gas Stops have a lower maintenance cost.

Industrial Appliance Section

American Gas Catalog and Handbook

Important and valuable information of interest to the industrial engineer and salesman is contained in the Industrial Appliance Section.

Some of the more important features in the 1928 Catalog are retained in this section. Attention is particularly called to the chart for determining the theoretical combustion of one pound of carbon, as well as to the chart which allows the determination of the comparative fuel cost, using fuel oil, producer gas, and blue gas.

Two new, important features consist of a comprehensive table showing the physical properties of a great variety of materials, such characteristics as the melting point, the boiling point, the latent heat of fusion, the latent heat of vaporization, the specific heat and the specific gravity. Another is a tabulation giving in considerable detail various properties and characteristics of gases, such as formulae, molecular weight, specific gravity, heat of combustion, air required for combustion, specific heat, etc.

PHYSICAL PROPERTIES OF VARIOUS SUBSTANCES

	Melting points in degrees Fahr.	Boiling points in degrees Fahr.	Latent heat of fusion in B.t.u. per lb.	Latent heat of vapor in B.t.u. per lb.	Specific heat	Specific gravity
Acetic acid	113	245	....	217.80	0.4125	1.602
Air	....	—311	....	....	....	....
Alcohol (grain)	....	173	....	376.05	0.7000	0.794
Alcohol (wood methyl)	....	150	....	520.2	0.4580	....
Almond oil	15	....	....	....	....	....
Alumina	....	....	....	....	0.1970	3.9
Aluminum	1,216	....	....	....	0.2185	2.67
Aluminum bronze	1,796	....	....	....	....	....
Ammonia	....	—37	....	535.26	....	0.6089
Ammonia, aqua	....	140	....	....	1.024	0.972
Aniline	—46	363	....	187.8	0.512	1.028
Antimony	1,166	2,732 to 3,092	....	....	0.0508	6.70
Arsenic	932	....	....	....	0.083	5.76
Arsenious chloride	....	....	....	95.40	....	....
Asphaltum	250	....	....	....	....	....
Barium	1,600	1,742	....	....	0.0470	4.00
Beeswax	145	....	76.14	....	0.4500	....
Benzene	....	176	55.63	167.22	0.4500	0.87
Bismuth	520	2,606	22.75	....	0.0380	9.81
Bonefat	70	....	....	....	....	....
Brass	1,869	....	....	....	0.0939	8.4
Bromine	19	145	29.12	82.80	0.1071 Liquid 1.11	2.97
Bronze	1,692	....	....	....	....	....
Butterfat	90	....	....	....	....	....
Cadmium	610	1,580	24.58	....	0.0567	8.6
Calcium	1,490	....	....	....	0.1670	1.58
Carbon	Infusible	....	....	....	0.4590	3.50
Carbon bisulphide	....	118	....	156.00	....	....
Carbonic acid	—108	....	....	....	....	....
Carbon dioxide	....	....	....	88.77	....	0.60
Carnubia wax	185	....	....	....	....	....
Castor oil	5	....	....	....	....	....
Cerium	1,292	....	....	....	0.0450	6.6
Chalk	....	....	....	....	0.2150	2.69
Charcoal	....	....	....	....	0.2410	....
Chlorine	....	—40	....	....	....	1.33
Chloroform	....	142	....	96.3	....	1.4
Chromium	2,750	....	....	....	0.0998	7.3
Clay burnt	....	....	....	....	0.1850	1.95
Coal tar	196	325	....	....	....	....
Cobalt	2,714	....	....	....	0.1069	8.65
Coke	....	....	....	....	0.2030	....
Cocoa butter	90	....	....	....	....	....
Cocoanut oil	75	....	....	....	....	....

	Melting points in degrees Fahr.	Boiling points in degrees Fahr.	Latent heat of fusion in B.t.u. per lb.	Latent heat of vapor in B.t.u. per lb.	Specific heat	Specific gravity
Cod liver oil	14	....	....	....	....	....
Copper	1,982	....	....	....	0.0951	8.952
Corundum	....	....	....	....	0.1980	3.89
Cotton seed oil	54	....	....	....	....	....
Cotton stearine	104	....	....	....	....	....
Cyanogen	—38	—6	....	....	....	0.866
Didymium	....	....	....	....	0.0456	6.54
Ether, ethyl	....	95	....	163.80	0.4810	0.71
Ethyl acetate	....	....	....	190.44	....	0.9007
Ethyl bromide	....	....	....	101.97	....	1.4
Ethyl chloride	....	....	....	160.47	....	0.917
Ethylene chloride	....	184	....	....	....	....
Ethyl formiaoride	....	....	....	189.54	....	0.906
Ethylene chlte	....	184	....	....	....	1.26
Ferro-nickel	2,660	....	....	....	....	8.1
Fir	....	....	....	....	0.6500	....
Fusel oil	....	269	....	....	0.5640	....
Fluorine	—369	—368.6	....	....	....	1.14
Formice acid	....	....	....	217.26	....	1.22
Gallium	....	....	34.40	....	0.079	5.96
Gasoline	....	175	....	....	....	....
Germanium	1,651	....	....	....	0.0737	5.469
Glass	1,500-2,300	....	....	....	0.1937	2.80
Gold	1,945	....	....	....	0.0324	19.25
Graphite	....	....	....	....	0.2020	....
Granite	....	....	....	....	....	2.65
Glucose	179.6	....	....	....	....	1.55
Glycerine	62.6	554	....	....	0.6120	1.266
Gypsum	....	....	....	....	0.1970	....
Hydrochloric acid	....	....	....	....	....	0.808
Hydrocyanic acid	....	79	....	....	....	0.70
Hydrofluoric acid	....	66	....	....	....	1.03
Hydrogen sulphide	....	—101	....	....	....	0.91
Hyponitric acid	16	....	....	....	....	....
Ice	32	....	142.65	....	0.5040	....
Indium	....	....	....	....	0.0570	7.1
Iodine	240	347	21.06	5.31	0.0541	4.94
Iridium	3,632	....	....	....	0.0326	21.75
Iron, cast gray	2,228	....	41.40	....	0.1298	7.28
Iron, cast white	2,075	....	59.40	....	....	7.65
Iron, wrought	2,900	....	....	....	0.1138	7.7
Lard	95	....	....	....	....	....
Lanthanum	....	....	....	....	0.0449	6.16
Lead	618	2,912	9.66	....	0.0314	11.38
Lead, melted	....	....	....	....	0.0402	11.00
Linseed oil	60	597	....	....	0.5300	0.94
Magnesium	1,204	2,012	....	....	....	1.75
Magnesia	....	....	....	....	0.2220	....
Manganese	2,237	....	....	....	0.1441	8.03

	Melting points in degrees Fahr.	Boiling points in degrees Fahr.	Latent heat of fusion in B.t.u. per lb.	Latent heat of vapor in B.t.u. per lb.	Specific heat	Specific gravity
Marble	....	....	....	....	0.2100	2.70
Mercury	—39	676	5.09	111.60	0.0333	13.60
Mercuric chloride	....	572	....	....	....	5.75
Methyl acetate	....	....	....	198.36	....	0.919
Methyl formate	....	....	....	210.78	....	0.97
Milk	....	....	....	....	....	1.032
Molybdenum	3,992	....	....	....	0.0722	8.56
Naphtha	....	185	....	....	....	....
Naphthalene	....	....	....	....	....	1.15
Neatsfoot oil	40	....	....	....	....	....
Nickel	2,646	....	....	....	0.1086	9.50
Nitric acid	—42	248	....	217.14	....	1.420
Nitric anhydride	....	....	....	80.65	....	1.55
Nitrous oxide	....	....	....	181.08	....	0.836
Nitro-glycerine	45	....	....	....	....	1.595
Oak	....	....	....	....	0.5700	....
Olive oil	36	....	....	....	0.3100	0.92
Osmium	4,892	....	....	....	0.0311	22.47
Oxygen	....	—204	....	....	....	....
Palladium	2,822	....	65.34	....	0.0593	11.8
Palm oil	104	....	....	....	....	....
Paraffine	130	....	63.27	....	....	0.90
Petroleum	....	316	....	....	0.4340	....
Pear wood	....	....	....	....	0.5000	....
Phosphorous	112	554	9.06	....	0.1887	1.84
Phosphorous trichloride	....	....	....	92.55	....	1.59
Pine (turpentine)	....	....	....	....	0.4670	....
Pitch	91	....	....	....	....	....
Platinum	3,191	....	48.90	....	0.0324	21.15
Parpoise oil	3	....	....	....	....	....
Potassium	136	1,292	....	....	0.1700	0.86
Potassium nitrate	....	....	85.26	....	....	2.00
Potassium sulphate	1,859	....	....	....	....	2.66
Quartz	....	....	....	....	0.1880	2.65
Quicklime	....	....	....	....	0.2170	2.078
Rhodium	3,525	....	....	....	0.0580	11.0
Rubidium	101	....	....	....	....	1.52
Ruthenium	....	....	....	....	0.0611	11.2
Sal-ammoniac (NH_4Cl)	....	257	....	....	....	1.5
Salt, saturated sol	....	226	....	....	....	....
Salt (common) (NaCl)	1,421.6	....	....	....	....	2.13
Saltpeter	600	....	....	....	....	2.09
Sand (river)	....	....	....	....	0.1950	1.80
Seal oil	37	....	....	....	....	....
Sea water	....	....	....	....	....	1.026
Selenium	422	....	....	....	....	4.3
Silica	....	....	....	....	0.1910	2.89
Silicon	2,372	....	....	....	0.2030	2.49
Silver	1,762	....	37.93	....	0.0570	10.4
Soda	....	....	....	....	0.2310	2.41

	Melting points in degrees Fahr.	Boiling points in degrees Fahr.	Latent heat of fusion in B.t.u. per lb.	Latent heat of vapor in B.t.u. per lb.	Specific heat	Specific gravity
Sodium	205	1,485	....	....	0.2934	0.97
Spermaceti	120	....	66.56	....	....	1.00
Sperm oil	—13	....	....	....	....	....
Stearic acid	158	....	....	....	....	0.8521
Stearin	120	....	....	....	....	0.96-1.0179
Steel	....	....	36.00	....	....	....
Steel, hard	2,570	....	....	....	0.1175	7.84
Steel, soft	2,687	....	....	....	0.1165	7.78
Strontium	1,112	....	....	....	....	2.50
Stannic chloride	....	....	....	54.95	....	2.24
Sulphur	239	570-824	16.86	651.60	0.2026	2.07
Sulphur (melted)	....	....	....	....	0.2340	1.45-1.81
Sulphuric anhydride	....	....	....	264.69	....	1.85
Sulphuric acid	....	590	....	219.79	0.3350	1.84
Sulphurous acid	—148	....	....	....	....	....
Sulphur dioxide	....	....	....	170.20	....	1.35
Sunflower oil	1	....	....	....	....	....
Tallow	92	....	....	....	....	....
Tar	....	....	....	....	0.4130	....
Tellurium	851	....	....	....	0.0475	6.15
Thallium	561	....	....	....	....	11.8
Tin	450	2,642	25.65	....	0.0562	7.35
Tin, melted	....	....	....	....	0.0637	7.35
Titanium	4,532	....	....	....	....	....
Tungsten	4,712	....	....	....	0.0363	17.4
Turpentine	14	....	....	133.25	0.4720	0.97
Turpentine oil	....	315	....	....	....	0.86
Uranium	4,352	....	....	....	0.0276	18.35
Vanadium	....	....	....	....	....	5.8
Varnish	....	600	....	....	....	....
Wax	150	....	....	....	....	....
Water	....	212	....	970.40	1.000	1.00
Whale oil	28	630	....	....	....	....
Wool fat	105	....	....	....	....	....
Zinc	787	1,904	50.63	....	0.0956	7.18
Zirconium	2,372	....	....	....	0.0660	4.15

CALORIFIC VALUES OF GAS-AIR MIXTURES OF THREE TYPICAL COMMERCIAL GASES

Constituent Gases	300 B.t.u. Water Gas		600 B.t.u. Carb. Water Gas		450 B.t.u. Coke-Oven Gas	
	Per Cent by Volume	B.t.u. per cu. ft. as burned	Per Cent by Volume	B.t.u. per cu. ft. as burned	Per Cent by Volume	B.t.u. per cu. ft. as burned
CO_2	8.2	...	4.8	...	3.2	...
Illuminats	1.4	1.4	12.8	12.7	3.0	3.0
O_2	0.3	...	0.3	...	1.0	...
CO	34.0	31.4	29.2	26.9	9.6	8.9
CH_4	1.9	1.9	14.2	14.0	22.8	22.6
H_2	50.4	46.8	35.0	32.5	41.5	38.5
N_2	3.8	...	3.7	...	18.9	...

A TABLE OF CONSTANTS FOR CERTAIN GASES AND VAPORS

I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
Name of Gas or Vapor	Formula	Molecular weight	Specific gravity gas or vapor at 60°F. Air=1.0	Boiling point °Fahr.	Specific gravity liquid at60°F. water=1.0	Specific heat eq. wts. at const. pres. water =1.0	Cubic feet per pound	Weight 1 cubic foot in pounds	Heat of combustion: Calories per molecular wt. in grammes	Heat of combustion: British Thermal Units: Per cu.ft.	Heat of combustion: British Thermal Units: Per Lb.
Carbon to CO	$^1C_2$	24	0.8292	.....	.....	.....	15.749	.06350	29,000	276.2	4,350
Carbon to CO_2	$^1C_2$	24	0.8292	.....	.....	.....	15.749	.06350	96,960	923.5	14,544
Carbonic oxide	CO	28	0.9671	.....	.....	0.2450	13.503	.07407	67,960	323.5	4,368
Hydrogen	H_2	2	0.0692	.....	.....	3.4090	188.620	.00530	68,360	326.2	61,523
Methane	CH_4	16	0.5529	.....	.....	0.5929	23.626	.04234	211,930	1009.0	23,838
Ethane	Paraffin series C_2H_6	30	1.0368	.....	.....	.....	12.594	.07940	370,440	1764.4	22,226
Propane	Paraffin series C_3H_8	44	1.5206	− 13°	.....	.....	8.587	.11645	529,210	2521.0	21,651
Butane	C_nH_{2n+2} C_4H_{10}	58	2.0045	+ 33°	.....	.....	6.514	.15350	687,190	3274.0	21,326
Pentane	C_5H_{12}	72	2.4883	+100°	0.6273	.....	5.248	.19055	847,110	4035.6	21,177
Hexane	C_6H_{14}	86	2.9721	+156°	0.6640	.....	4.393	.22760	999,200	4759.8	20,914
Ethylene	Olefin series C_2H_4	28	0.9676	.....	.....	0.4040	13.495	.07410	333,350	1588.0	21,430
Propylene	Olefin series C_3H_6	42	1.4514	.....	.....	.....	8.997	.11115	492,740	2347.2	21,120
Butylene	C_nH_{2n} C_4H_8	56	1.9353	+ 23°	.....	.....	6.747	.14820	650,620	3099.2	20,913
Amylene	C_5H_{10}	70	2.4191	+102°	0.6511	.....	5.398	.18525	807,630	3847.2	20,767
Acetylene	Acetylene series C_2H_2	26	0.8984	.....	.....	.....	14.534	.06880	310,050	1476.7	21,465
Allylene	Acetylene series C_3H_4	40	1.3823	.....	.....	.....	9.447	.10585	467,550	2227.1	21,040
Crotonylene	C_nH_{2n-2} C_4H_6	54	1.8661	+ 64°	.....	.....	6.998	.14290	.....	.....	.....
Benzene	C_6H_6	78	2.6953	+177°	0.8846	0.3754	4.845	.20640	799,350	3807.5	18,447
Toluene	Aromatic series C_7H_8	92	3.1792	+230°	0.8720	.....	4.107	.24345	955,680	4552.0	18,699
Xylene	Aromatic series C_8H_{10}	106	3.6630	+287°	0.8692	.....	3.565	.28050	.....	.....	.....
Mesitylene	C_nH_{2n-6} C_9H_{12}	120	4.1468	+326°	.....	.....	3.149	.31755	1,282,310	6108.0	19,235
Naphthalene	$C_{10}H_8$	128	4.4230	+424.4°	1.1517	.....	2.952	.33870	.....	.....	.....
Hydrogen sulphide	H_2S	34	1.1769	.....	.....	0.2423	11.096	.09012	140,900	672.2	7,459
Ammonia	NH_3	17	0.5888	.....	.....	0.5083	22.178	.04509	90,650	432.8	9,598
Hydrocyanic acid	HCN	27	0.9348	.....	.....	.....	13.968	.07159	158,620	757.0	10,575
Cyanogen	C_2N_2	52	1.8000	.....	.....	.....	7.258	.13779	259,620	1238.2	8,986
Carbon bi-sulphide	CS_2	76	2.6298	+114.8°	.....	.....	4.965	.20139	265,130	1264.6	6,279
Methyl alcohol	CH_4O	32	1.1121	+131.2°	0.8027	.....	11.742	.08516	182,230	872.9	10,250
Ethyl alcohol	C_2H_6O	46	1.5894	+172.9°	0.7946	1.4534	8.216	.12172	340,530	1622.0	13,325
Carbonic acid	CO_2	44	1.5195	.....	.....	0.2163	8.593	.11637	.....	.....	.....
Water	H_2O	18	0.6217	+212°	1.0000	0.4805	21.004	.04761	.....	.....	.....
Sulphur dioxide	SO_2	64	2.2128	.....	.....	0.1553	5.901	.16945	.....	.....	.....
Oxygen	O_2	32	1.1052	.....	.....	0.2174	11.816	.08463	.....	.....	.....
Nitrogen	N_2	28	0.9701	.....	.....	0.2438	13.460	.07429	.....	.....	.....
Air	...	..	1.0000	.....	.....	0.2374	13.059	.07658	.....	.....	.....

XIII	XIV	XV	XVI	XVII	XVIII	XIX	XX	XXI	XXII	XXIII	XXIV	XXV	XXVI
Cu. ft. per cu. ft. of combustible					Pounds per pound of combustible					Ht. of formation at const. pres.			
Req. for combustion		Products of combustion			Req. for combustion		Products of combustion			Calories per molecular wt. in grms.	B. T. U.		Name of Gas or Vapor
Air	Oxygen	CO_2	H_2O		Air	Oxygen	CO_2	H_2O			Per cu. ft.	Per Lb.	
4.785	1.0	...	...	CO−2.0	5.771	1.333+	.....	.....	CO−2.333+	.....	.....	.....	Carbon, to CO
9.570	2.0	2.0	...	.....	11.541	2.666+	3.666+	.....	.....	.....	.....	.....	Carbon, to CO_2
2.393	0.5	1.0	...	.....	2.471	.571	1.571	.....	.....	.....	+138.4	+1869.2	Carbonic oxide
2.393	0.5	...	1.0	.....	34.624	8.000	.....	9.000	.....	.....	.....	.....	Hydrogen
9.570	2.0	1.0	2.0	.....	17.312	4.000	2,750	2.250	.....	+21,750	+103.1	+2435.6	Methane
16.748	3.5	2.0	3.0	.....	16.156	3.733	2.933	1.800	.....	+28,560	+136.0	+1713.6	Ethane
23.925	5.0	3.0	4.0	.....	15.737	3.636	3.000	1.636	.....	+35,110	+167.2	+1436.3	Propane
31.103	6.5	4.0	5.0	.....	15.520	3.586	3.034	1.552	.....	+42,450	+202.2	+1317.3	Butane
38.280	8.0	5.0	6.0	.....	15.386	3.555	3.055	1.500	.....	+47,850	+227.9	+1196.2	Pentane
45.458	9.5	6.0	7.0	.....	15.295	3.534	3.069	1.465	.....	+61,080	+290.9	+1278.4	Hexane
14.355	3.0	2.0	2.0	.....	14.836	3.428	3.142	1.286	.....	− 2,710	− 12.9	− 174.2	Ethylene
21.533	4.5	3.0	3.0	.....	14.836	3.428	3.142	1.286	.....	+ 3,220	+ 15.3	+ 138.0	Propylene
28.710	6.0	4.0	4.0	.....	14.836	3.428	3.142	1.286	.....	+10,660	+ 50.7	+ 342.6	Butylene
35.888	7.5	5.0	5.0	.....	14.836	3.428	3.142	1.286	.....	+18,970	+113.7	+ 614.1	Amylene
11.963	2.5	2.0	1.0	.....	13.313	3.076	3.384	0.692	.....	−47,770	−227.5	−3300.7	Acetylene
19.140	4.0	3.0	2.0	.....	13.850	3.200	3.300	0.900	.....	−39,650	−188.8	−1784.2	Allylene
26.318	5.5	4.0	3.0	.....	14.105	3.259	3.259	1.300	.....	.....	.....	.....	Crotonylene
35.888	7.5	6.0	3.0	.....	13.313	3.076	3.384	0.692	.....	−12,510	− 47.3	− 229.3	Benzene
43.065	9.0	7.0	4.0	.....	13.547	3.130	3.348	0.782	.....	− 3,520	− 16.7	− 68.8	Toluene
50.243	10.5	8.0	5.0	.....	13.720	3.170	3.311	0.849	.....	.....	.....	.....	Xylene
57.420	12.0	9.0	6.0	.....	13.850	3.200	3.300	0.900	.....	+ 490	+ 2.3	+ 7.3	Mesitylene
57.420	12.0	10.0	4.0	.....	12.984	3.000	3.437	0.563	.....	.....	.....	.....	Naphthalene
7.178	1.5	...	1.0	SO_2−1.0	6.111	1.412	.....	0.529	SO_2−1.883	+ 4,740	+ 22.6	+ 250.9	Hydrogen sulphide
3.589	0.75	...	1.5	N−0.5	6.111	1.412	.....	1.588	N−0.823	+11,890	+ 56.7	+1259.0	Ammonia
5.981	1.25	1.0	0.5	N−0.5	6.410	1.481	1.630	0.333	N−0.518	−27,480	−131.1	−1832.0	Hydrocyanic acid
9.570	2.0	2.0	...	N−1.0	5.323	1.230	1.692	.....	N−0.538	−65,700	−313.2	−2273.9	Cyanogen
14.355	3.0	1.0	...	SO_2−2.0	5.466	1.263	0.579	.....	$SO_2$1.684	−26,010	−124.0	− 616.0	Carbon bi-sulphide
7.178	1.5	1.0	2.0	.....	6.492	1.500	1.375	1.125	.....	+51,450	+246.4	+2894.0	Methyl alcohol
14.355	3.0	2.0	3.0	.....	9.033	2.087	1.913	1.174	.....	+58,470	+278.5	+2288.0	Ethyl alcohol
.....	...	...	...	.....	.....	.....	.....	.....	.....	.....	+463.1	+3979.1	Carbonic acid
.....	...	...	...	.....	.....	.....	.....	.....	.....	.....	+327.1	+6870.4	Water
.....	...	...	...	.....	.....	.....	.....	.....	.....	.....	+337.3	+1999.1	Sulphur dioxide
.....	...	...	...	.....	.....	.....	.....	.....	.....	.....	.....	.....	Oxygen
.....	...	...	...	.....	.....	.....	.....	.....	.....	.....	.....	.....	Nitrogen
.....	...	...	...	.....	.....	.....	.....	.....	.....	.....	.....	.....	Air

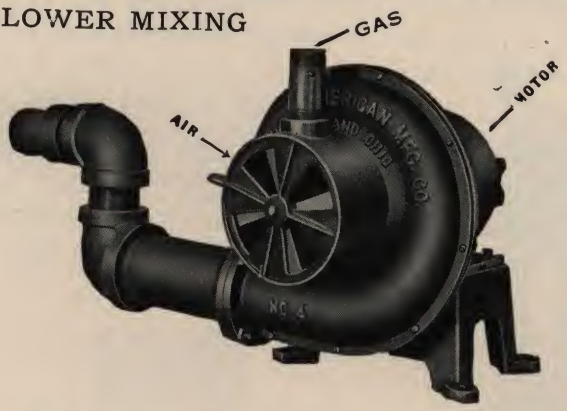
THE NORTH AMERICAN MANUFACTURING CO.

2906 EAST 75TH STREET
CLEVELAND, OHIO

SALES ENGINEERS IN PRINCIPAL CITIES

PRODUCTS: Industrial Gas-Burning Equipment, Gas-Electric Blowers, Turbo Pressure Blowers, Gas-Mixers, Gas Burners, Torches, Air Valves, Nozzles and other gas burning apparatus for Heat Treating and various Industrial uses. Made for both Manufactured and Natural Gas.

BLOWER MIXING



Showing method of introducing gas into North American gas-electric blower where it is mixed with the gas and delivered under blast to the nozzle.

INDIVIDUAL MIXING

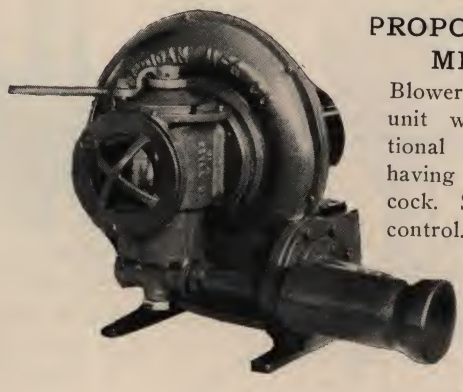
By this method, a North American Blower furnishes the air only for any number of gas burners. The gas is introduced at each individual North American mixer and burner.

ELBOW TYPE BLAST BURNERS

Siphon elbow type, combining mixer and nozzle as one gas burner. Used for blast fires with low pressure gas and air furnished from a blower, either natural or manufactured gas being introduced at the burner. Furnished with either plain or torch type nozzles.

TURBO BLOWERS

Made in sizes to deliver pressures up to 2 lbs. Cut shows threaded vacuum suction flange on intake. All Turbos can be furnished with guard, adjustable air shutter or threaded flange on intake.



PROPORTIONAL MIXING

Blower gas burning unit with proportional mixing valve having external gas cock. Single valve control. Valves also furnished separately for insertion in manifold.

AUTOMATIC CONTROL

Gas-electric blower unit with proportioning gas and air mixing valve operated by automatically controlled motor.

INSPIRATOR GAS BURNERS

For high pressure gas at 5 or 10 lbs. and upward.

AUTHORITIES AND METHODS OF CALCULATION

All Volumes of Gases and Vapors are given at 60° F. and 30″ pressure. The Temperature of Products of Combustion is reduced to 18° C. =64.4° F.

Column IV is calculated by the formula:

$$\text{sp. gr.} = \frac{\text{wt. 1 cu. ft. gas,}}{\text{wt. 1 cu. ft. air}}$$

and the figures thus obtained agree with the theoretical formula:

$$\text{sp. gr.} = \frac{\text{mol. wt.}}{28.94}$$

Columns V and VI are taken chiefly from Lunges "Coal Tar and Ammonia."

Column VII is from Ganot's "Physics," edition 1896, page 445.

Columns X and XXII are from Julius Thomsen's "Thermochemical Investigations," and his results are translated into English units in columns XI-XII and XXIV-XXV.

Columns XIII and XVIII are calculated on the assumption that

air = 20.9% oxygen + 79.1% nitrogen by volume.

air = 23.13% oxygen + 76.87% nitrogen by weight.

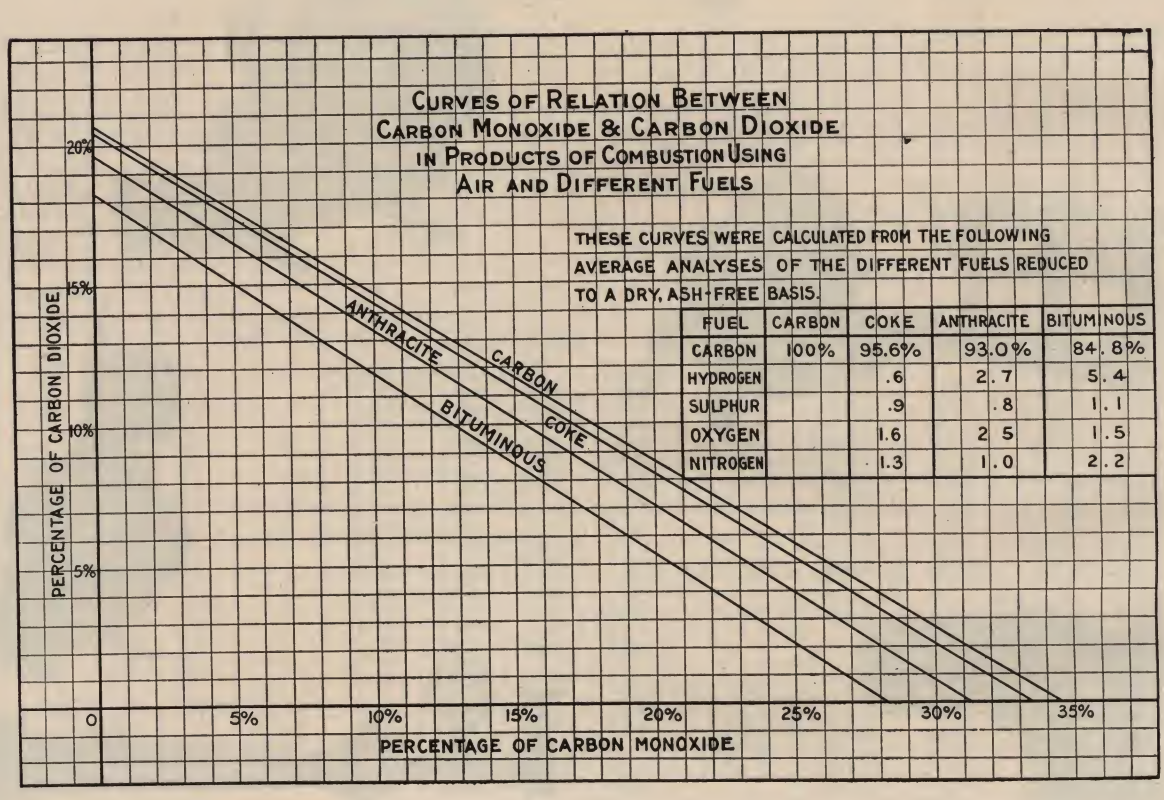
In column IX the figures given in Hempel's "Gas Analysis," p. 375, were selected for the fundamental weight of oxygen, nitrogen, hydrogen, carbonic oxide and air.

The formula used for the conversion to English units is—grammes per liter at 0° C. and 760 mm. x .05922 = pounds per cu. ft. at 60° F. and 30″ pressure. The derivation of the factor employed is

$$.05922 = \frac{28.316 \times .0022046 \times 30.00 \times 492}{29.92 \times 520}$$

The weights of the compound gases are calculated from these data by Avogadro's law.

[1]Calculated for C_2 as a gas.



JOHNSON GAS APPLIANCE Co.

Cedar Rapids JOHNSON PATENTED DIRECT JET IOWA

Manufacturers of

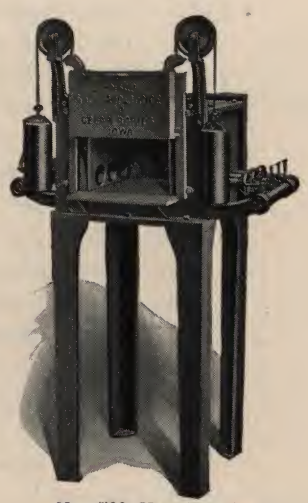
GAS APPLIANCES OF QUALITY

MELTING FURNACES

For Melting Soft Metals

Johnson melting furnaces are built in sizes ranging from 18 pounds capacity to 600 pounds capacity. Exclusive features of design and construction make these furnaces outstanding in strength, economy, and efficiency. City gas pressure only is required. No blowers needed. Free catalog gives full details.

No. 300
Melting Furnace



No. 700 Heat-Treating Furnace

HEAT-TREATING FURNACES

For Heat-Treating, Tempering, Annealing

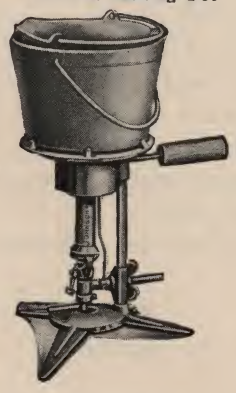
Any desired temperature up to 2,150 degrees F. may be maintained in the Johnson No. 700 Heat-Treating Furnace.
Designed for carbonizing, hardening, annealing, etc. No blowers needed. Built to withstand long, hard service. The No. 650 Heat-Treating Furnace is a somewhat smaller unit. Free catalog gives full details.

TORCHES

For Soldering and Pre-Heating Work

The Johnson line includes Direct Jet Hand Torches, Automatic Hand Torches, and the famous No. 8 Torch & Melting Pot. These products need only to be connected to city gas and they operate without forced air blast.
Their serviceability and efficiency are well known wherever gas is used. Free catalog gives full details.

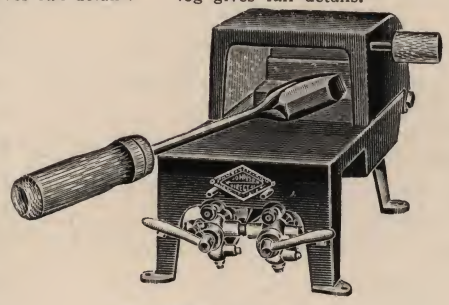
No. 8
Torch & Melting Pot



BENCH FURNACES

For Heating Soldering Irons

Johnson Bench Furnaces are made in a variety of sizes and types. Each embodies those principles of heat utilization which have made the name Johnson famous. These furnaces connect with city gas and operate without forced air blast. Free catalog gives full details.

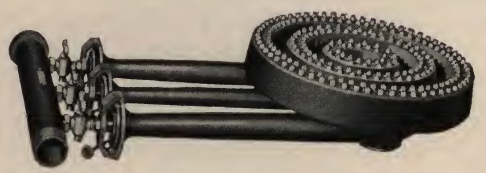


No. 101 Bench Furnace

GAS BURNERS

For Any Requirement

We make atmospheric ring burners, tee head burners, mixers, valves, gas cocks, bunsen burners, laboratory burners, etc. Burners of any special type to suit non-standard requirements are also made to order. Write to us for any information which you may need regarding gas burners.



No. 60 BCE Ring Burner

Write for Free Catalog

EFFECTS OF HEAT

	Deg. Fahr		Deg. Fahr.
Soft iron melts	3,945	Steel becomes a full blue	560
Cast iron melts	2,786	Sulphur burns	560
Gold melts	2,016	Steel becomes blue	550
Copper melts	1,996	Steel becomes purple	530
Silver melts	1,873	Steel becomes brown, with purple spots	510
Bronze (copper 15 parts, tin 1 part) melts	1,750	Steel becomes brown	490
Brass (copper 3 parts, zinc 1 part) melts	1,690	Bismuth melts	476
Brass (copper 2 parts, zinc 2 parts) melts	1,672	Steel becomes a full yellow	470
Diamond burns	1,552	Steel becomes a pale straw color	450
Bronze (copper 7 parts, tin 1 part) melts	1,534	Tin melts	442
Bronze (copper 3 parts, tin 1 part) melts	1,446	Steel becomes a very faint yellow	430
Enamel colors burn	1,392	Tin 3 + lead 2 + bismuth 1 melts	334
Iron red hot in daylight	1,272	Tin and bismuth, equal parts, melts	283
Iron red hot in twilight	884	Sulphur melts	218
Iron red hot in dark	800	Bismuth 5 + tin 3 + lead 2 melts	212
Charcoal burns	802	Water boils	212
Heat of a common fire	790	Wax melts	149
Zinc melts	773	Tallow melts	92
Mercury boils	660	Acetic acid congeals	50
Linseed oil boils	640	Olive oil congeals	36
Lowest ignition of iron in the dark	635	Water freezes	32
Lead melts	612	Milk freezes	30
Steel becomes dark blue, verging on black	600	Vinegar freezes	28
		Sea water freezes	28
		Strong wine freezes	20
		Turpentine freezes	14

COLORS AT DIFFERENT TEMPERATURES

	Deg. Fahr.		Deg. Fahr.
Faint red	960	Welding heat	2,800
Dull red	1,290	Greatest heat of iron blast furnaces	3,300
Brilliant red	1,470	600° F. Faint red in dark room.	
Cherry red	1,650	662° F. Mercury boils.	
Bright cherry red	1,830	810° F. Antimony melts.	
Orange	2,010	1,869° F. Brass melts.	
Bright orange	2,190	1,873° F. Silver melts.	
White heat	2,370	1,996° F. Copper melts.	
Bright white heat	2,550	2,786° F. Cast Iron melts.	
Brilliant white heat	2,730	Temperature of iron when red glow has disappeared, 404° C.	
Melting point of cast iron	2,786		

Domestic Appliance Section

American Gas Catalog and Handbook

According to the standard set heretofore, the Domestic Appliance Section contains information that is specially applicable to a particular class of appliances as well as generally applicable to all. The important data on the details of the organization and activities of a domestic appliance department have been retained from last year. While a number of other tabulations and charts have been retained from last year as well, nevertheless, much new material has been added.

Mention may be made of a valuable tabulation on thermal conductivity of insulating materials, the calculation of saving effected by the insulation of houses in house heating. An easy method is given and an example is worked out whereby this can be accurately determined.

A chart is included showing the connections that are standard for incinerators.

A method and example of calculating the saving resulting from covering the hot water tank in heating water by gas are given. The relative costs of cooking with gas and with electricity are indicated in tabulated form for different rates, and a comparison is also made between the general characteristics of the gas range and the electric furnace.

A very important chart is included for determining the size of the orifice in domestic appliances.

Tables are given on flow of water in house pipes, capacities and other properties of tanks, etc.

HINTS AND SUGGESTIONS FOR THE MERCHANDISE MANAGER

The Organization. The organization of a merchandising department both in the gas company and in the dealer or department store enterprise consists basically of the following:

A. The Sales Manager—the chief of the department, and subordinate to him:

1. Store or floor salesmen.
2. Field or outside salesmen.
3. Clerks and bookkeepers.
4. Display and advertising assistants.
5. Service and delivery men.
6. Demonstrators.

The Duties. The duty of the sales manager and his assistant force is to sell gas merchandise. The sales manager has available several media for this purpose, and these are tabulated in detailed form, under the designation Merchandising Activities. (See 1927 Catalog.) The sales manager has, however, additional duties, which are as follows:

1. To buy merchandise of the right sort and at the right price.
2. To train his employees in their respective duties.
3. To price the merchandise so that it sells and sells at a profit.
4. To display the merchandise so that buyers are attracted.
5. To advertise the merchandise so that the customers are told what he has to offer them.
6. To supervise sales and service.

Displaying Merchandise—The Window Display. The essentials of a good window display are as follows:

1. It must have artistic setting and effect.
2. It must have proper balance and color.
3. It must be well lighted and attractively lighted, colored effects being correctly and artistically used to focus the attention of the observer. The color of the light used must be chosen with regard to the nature of the merchandise displayed.

(a) Red and amber for heaters.
(b) Blue for refrigerators.
(c) Green for cool, quiet effects.
(d) Green and amber for bright sunshine effects.
(e) Daylight effects for most any purpose.

4. It must be changed frequently.
5. It must create a desire for the object displayed by emphasizing in unmistakable fashion a need that it fills.
6. It must be accompanied by the proper display cards carrying the proper information in concise and accurate form.
7. It must not confuse the onlooker by containing too many objects.
8. It must carry a single item only in proper setting when displaying the larger appliances.
9. It must contain the articles, if many are displayed, properly grouped so that they impress and attract the window shopper.
10. It must not offend the eye by improper color contrasts.
11. It must interest the observer and yet its interest must not detract attention from the essential purpose of the display, namely, to encourage the purchase of gas appliances.

Displaying Merchandise—The Store and Counter Display. The essentials of good store and counter displays are as follows:

1. They must be instructive; that is, they must teach the observer some essential fact about the appliance.
2. They must be readily handable, that is when small appliances are displayed the articles must be easily within the reach of the customer who desires to examine them.
3. They must be changed often.
4. They must carry clear, concise and accurate display cards, giving price and other information in simple form.
5. They must be well lighted, or rather the rooms in which they occur must be well lighted. Color effects enhance the store displays, and the correct colors must be used as explained under Window Displays.

Advertising—Newspaper and Magazine. The essentials of good newspaper, trade paper and magazine advertising are as follows:

1. It must be well planned.
2. It must be well written, the language must be simple, concise and accurate, conveying the message in well directed fashion without being verbose.
3. Its form from a typographical standpoint must be correct.

4. It must be up-to-date as far as copy is concerned.

5. It must be timely, in accordance with the season of the year.

Advertising—Direct by Mail. The essentials of successful direct by mail advertising are as follows:

1. It must tie up in definite manner with newspaper advertising.

2. It must be carefully planned.

3. It must be written in simple, straightforward style.

4. Its message must be clear and not complicated by attempting to give more than one message in one piece of copy.

5. It must be sent out to a carefully prepared list so that it brings best results. The list is just as important, if not more so, than the advertising copy itself.

Sales Campaign. (The essentials of a good sales campaign are described in another part of this section.)

Forms. Standard types of forms used are as follows:

1. Application Form. Application for employment.

2. Prospect Card. For salesmen to record progress of sale to prospect.

3. Salesman's Daily Report. To record orders taken for connection and sales made.

4. Sales Contract.

5. Request for Free Demonstration.

6. Home Service Report.

7. Survey Card. To record results of canvass amongst users of gas service to determine market for appliances.

RELATIVE COOKING COSTS WITH GAS AND ELECTRICITY

Cost of Electricity per Kw.-hr.	Cost of Gas per 1,000 Cu. Ft. Manufactured (525 B.t.u.)	Natural (1050 Bt.u.)	Cost Ratio to Mfd. Gas Electricity	Cost Ratio to Natural Gas Electricity
$0.10	$0.75	$0.25	1.02	6.15
0.02			2.05	12.29
0.03			3.07	18.4
0.04			4.10	24.6
0.01	1.00	0.50	0.77	3.07
0.02			1.54	6.14
0.03			2.31	9.21
0.04			3.08	12.29
0.05			3.85	15.26
0.02	1.25	0.75	1.23	4.10
0.03			1.85	6.15
0.04			2.46	8.20
0.05			3.08	10.25
0.02	1.50	1.00	1.03	3.07
0.03			1.54	4.61
0.04			2.05	6.14
0.05			2.56	7.68
0.02	2.00	1.25	0.77	2.46
0.03			1.15	3.69
0.04			1.54	4.92
0.05			1.91	6.15

A COMPARISON OF THE GAS AND THE ELECTRIC RANGE

1. Either gas or electric ranges may be secured in a sufficiently wide variety of models to meet ordinary needs. Where space is limited gas ranges afford more range of choice.

2. The initial cost of the electric range will be approximately twice as much as the usual gas range, and on account of the construction of its heating elements its upkeep costs will be higher. Further, the installation costs are more for the electric range.

3. Both ranges are convenient in use, the electric range being more easily cleaned, and, through its insulation, tending to allow lower temperatures in the kitchen during hot weather. Insulated ovens may be obtained on gas ranges, though comparatively few are now in use.

4. The gas range is much faster in operation than the electric, particularly for cooking top work. This results in a great saving of time to the housewife, which, in view of changing living conditions, is daily becoming a more important consideration.

5. Electric ranges have greater thermal efficiency than gas, requiring on an average about one-half as much energy to do the same work. This is more than offset by the higher price of electricity. In general, electric range cooking will probably cost twice as much as with gas. The efficiency of the electric range apparently decreases with use, and varies with the size of the vessel.

6. Little difference can be found in the effects on food cooked by either type of range.

7. While each range has some advantages over the other, the lower first cost, upkeep and installation costs of the gas range, with its lower operating cost and advantage in cooking speed, will probably always prove most practical for use in the average American home.

*FLOW IN GALLONS PER MINUTE DELIVERED BY ORDINARY PLUMBING FIXTURES

Fixture	1 Fair Flow	2 Good Flow	3 Excellent Flow
Kitchen Sink Bibbs	2	4	6
Pantry Sink—High Goose Neck Bibbs	2	2	3
Pantry Sink—Large Plain Bibbs	4	6	8
Vegetable Sink Bibbs	2	4	6
Laundry Tray Bibbs	4	6	8
Slop Sink Bibbs	3	4	6
Lavatory Basin Bibbs	2	3	4
Bathtub Bibbs	3	4	6
Shampoo Spray	½	1	2
Liver Spray	1	2	3
Shower Baths			
4″ Rain Heads	2	3	4
6″ Rain Heads	2	3	5
8″ Rain Heads	4	6	8
8″ Tubular Heads	6	8	10
Needle Baths	20	30	40
Manicure Tables	1	1½	2

* Compiled from tests on water pressure of 30 pounds per square inch.

1. Fair flow—stream just large enough to render good service.
2. Good flow—generally satisfactory flow.
3. Excellent flow—such flow which when increased to any great strength causes annoyance by splashing and noise.

American Gas Catalog and Handbook

Flow of Water in House Service Pipes

Condition of Discharge	Pressure in Main Lbs. Per Sq. In.	Discharge or quantity capable of being delivered per minute, under conditions specified at the left. NOMINAL DIAMETER OF PIPE IN INCHES ½" Cu. Ft.	½" Gal.	¾" Cu. Ft.	¾" Gal.	1" Cu. Ft.	1" Gal.	1½" Cu. Ft.	1½" Gal.	2" Cu. Ft.	2" Gal.
Through 35	30	1.10	8.2	3.01	22.5	6.13	45.8	16.58	124.	33.34	249
Feet of	40	1.27	9.5	3.48	26.0	7.08	52.9	19.14	143.	38.50	288
Service Pipe	50	1.42	10.6	3.89	29.1	7.92	59.3	21.40	160.	43.04	322
No Back	60	1.56	11.7	4.26	31.8	8.67	64.8	23.44	175.	47.15	352
Pressure	75	1.74	13.0	4.77	35.6	9.70	72.6	26.21	196.	52.71	394
Through 100	30	0.66	4.94	1.84	13.8	3.78	28.2	10.40	77.8	21.30	159
Feet of	40	0.77	5.77	2.12	15.9	4.36	32.6	12.01	90.0	24.59	184
Service Pipe	50	0.86	6.44	2.37	17.7	4.88	36.5	13.43	100.0	27.50	206
No Back	60	0.94	7.03	2.60	19.4	5.34	39.9	14.71	110.0	30.12	225
Pressure	75	1.05	7.85	2.91	21.8	5.97	44.7	16.45	123.0	33.68	252
Through 100 Ft.	30	0.55	4.12	1.52	11.4	3.11	23.3	8.57	64.1	17.55	131
of Service Pipe	40	0.66	4.94	1.81	13.5	3.72	27.8	10.24	76.5	20.95	157
15 Feet	50	0.75	5.61	2.06	15.4	4.24	31.7	11.67	87.2	23.87	179
Vertical	60	0.83	6.21	2.29	17.1	4.70	35.2	12.94	96.8	26.48	198
Rise	75	0.94	7.03	2.59	19.4	5.32	39.8	14.64	109.0	29.96	224
Thru 100 Feet	30	0.44	3.29	1.22	9.1	2.50	18.7	6.80	50.9	14.11	106
of Service	40	0.55	4.12	1.53	11.4	3.15	23.6	8.68	65.0	17.79	135
Pipe, 30 Feet	50	0.65	4.87	1.79	13.4	3.69	27.6	10.16	76.0	20.82	156
Vertical	60	0.73	5.46	2.02	15.1	4.15	31.1	11.45	85.6	23.47	176
Rise	75	0.84	6.29	2.32	17.3	4.77	35.7	13.15	98.4	26.95	202

WATER TEMPERATURE REQUIRED FOR VARIOUS CLASSES OF SERVICE

	Minimum °F.	Maximum °F.
Garages (for washing cars)	80	100
General domestic use	130	160
Laundry (hand work)	115	212
Laundry (machine work)	180	212
Barber Shop (not sterilizing)	115	150
Bars and soda fountain (hot drinks)	175	212
Lavatory and cleaning uses	115	150
Baths only	110	150
Shower baths	110	150
Swimming pools	80	212
Baptistries	80	212
Dishwashing (hand work)	130	212
Dishwashing (machine)	180	212
Milk dealers (not sterilizing or pasteurizing)	115	150

CONTENTS OF WATER PIPES PER TEN-FOOT LENGTH

10 ft.	length	of	¼	in.	pipe	contains	.054	gal.	10 ft.	length	of	1¼	in.	pipe	contains	.777	gal.
10 "	"	"	½	"	"	"	.158	"	10 "	"	"	1	"	"	"	.447	"
10 "	"	"	⅜	"	"	"	.099	"	10 "	"	"	1½	"	"	"	1.058	"
10 "	"	"	¾	"	"	"	.277	"	10 "	"	"	2	"	"	"	1.743	"

Data on Tanks

Nominal Capacity Gallons	Diameter Inches	Length Feet	Surface Area Sq. Ft.	HEAT LOSS PER HOUR 80° Diff. B.t.u.	90° Diff. B.t.u.	100° Diff. B.t.u.
30	12	5	17.3	2910	3320	3720
40	14	5	20.4	3430	3910	4390
65	20	4	25.3	4250	4850	5440
85	20	5	31.6	5310	6050	6800
100	22	5	34.1	5730	6540	7330
100	24	4	28.4	4770	5440	6110
120	24	5	37.7	6340	7220	8100
140	24	6	43.9	7380	8410	9450
150	30	4	41.2	6930	7900	8850
180	30	5	49.0	8240	9400	10500
220	30	6	56.9	9560	10900	12200
250	30	7	64.8	10900	12400	13900
295	30	8	72.6	12200	13900	15600
315	36	6	70.6	11900	13500	15200
365	36	7	80.1	13500	15350	17200
420	36	8	89.5	15100	17150	19250
525	36	10	108.3	18200	20750	23200
430	42	6	85.2	14300	16300	18300
500	42	7	96.2	16200	18400	20700
575	42	8	107.2	18000	20550	23000
720	42	10	129.2	21700	24750	27800
865	42	12	151.2	25400	28950	32500
1000	42	14	173.2	29100	33150	37200
1130	48	12	175.8	29500	33650	37800
1300	48	14	201.1	33800	38550	43200
1500	48	16	226.1	38000	43300	48600
1700	48	18	251.1	42200	48100	54000

SAVING OF GAS FROM COVERING HOT WATER TANK

What number of feet of natural gas should be saved per hour from covering a steel hot water tank with 1½ in. asbestos block? The area of tank surface to be covered is 66 sq. ft. The tank is kept filled with water at the temperature of 210 deg. Fahr. and is supplied at the rate of 250 gal. of water per hour through a copper coil, gas heated water heater which receives the water at the temperature of 60 deg. Fahr.

Assuming that the atmosphere surrounding the tank is at the temperature of 70 deg. Fahr., the temperature difference is 210 — 70 = 140 deg. Fahr. With this difference the loss of heat by radiation to the surrounding air could be about 1 B.t.u. per degree difference of tem-

perature per sq. ft. of bare surface per hour; that is, without covering, the loss would be

$140 \times 2.1 \times 66 = 19{,}404$ B.t.u. per hour.

Average natural gas has a heat value of about 1,000 B.t.u. per cubic foot, and allowing 50 per cent efficiency for the heater, the radiation of heat from the bare water tank would require combustion of about

$19.404 \div (1000 \times 0.5) = 38.8$ cu. ft. of gas per hour.

The efficiency of 1½ in. asbestos block covering would be about 75 per cent, and the actual saving would be approximately 75 per cent of $38.8 = 29.1$ cu. ft. of natural gas per hour, or about 0.44 cu. ft. of gas per hour per sq. ft. of the covering.

DETERMINING SIZE OF ORIFICE ON DOMESTIC APPLIANCES

Suppose that an orifice in a spud of Type I (see chart on page 160) is to be used and the conditions of supply are as follows: heating value, 500 B.t.u. per cubic foot; specific gravity, 0.5; prassure on the orifice, 3.5 inches of water column, and the size fo the orifice required to discharge a quantity of gas that will liberate 23,500 B.t.u. per hour is required.

A straight-edge aligning the heating value, found on the second scale from the left, with the heat input, given on the middle scale, will intercept the third scale from the right to show the discharge per hour. Aligning this point and the value for specific gravity, found on the lower scale at the extreme left, gives a point on the products line, located near the center. Further aligning this point and the value for the pressure used, on the upper scale at the extreme left, will give an intercept on the second scale from the left, on the left side of which can be read the size of the orifice to be used.

If the spud used is of Type II, that is, with a 15-degree angle of approach, the size of orifice is read on the right of the same scale. If a spud of Type II is used in a standard range cock and only the pressure before the cock is known, the size of the orifice to be used is found on the scale for orifices in a spud of Type II directly to the right, the size of the orifice to be used being found on the scale to the extreme right.

If, conversely, the discharge of a certain orifice is desired, the procedure is just the reverse to that given above. Beginning with orifice size, align with pressure to find a point on the products line; align this point and specific gravity to determine discharge; then align discharge and heating value to find the heat input.

FLUE CONNECTIONS FOR INCINERATORS

1. Locate incinerator as near as possible to chimney to which connection is to be made. Wherever possible, connect direct into chimney.

2. If furnace or other appliance is connected to the same flue, make the connection for incinerator above furnace connection. (See Exhibit "A.")

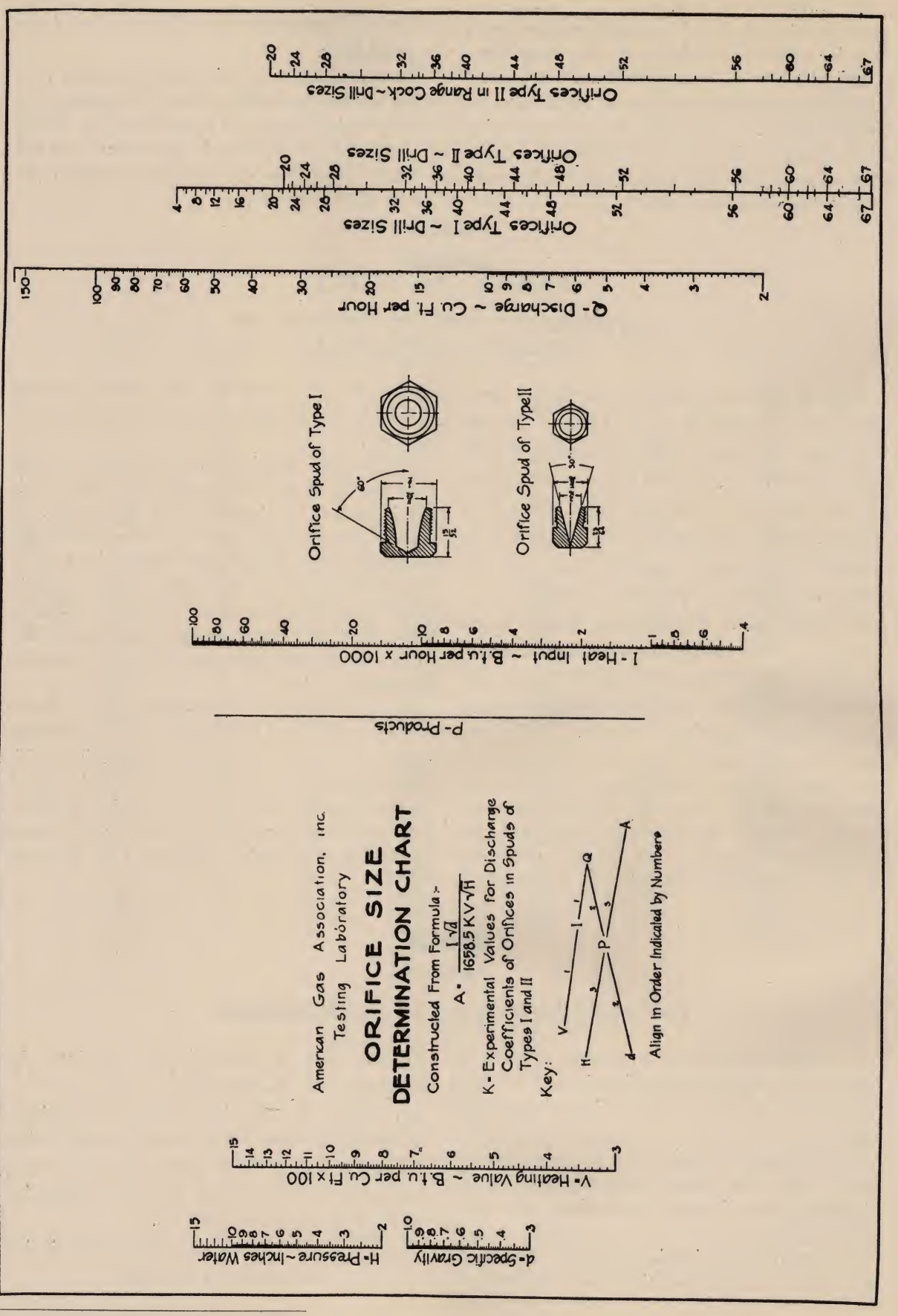
3. Extend flue pipe just through the chimney wall. Proper operation will not result if the flue pipe is extended too far into the chimney. (See Exhibit "D.")

4. Run 8-in. flue pipe between the incinerator and chimney. Never reduce at any point.

5. If necessary to connect incinerator with furnace or other flue pipe, be sure to angle in; never T in. (See Exhibit "C.")

6. The minimum round chimney flue, inside

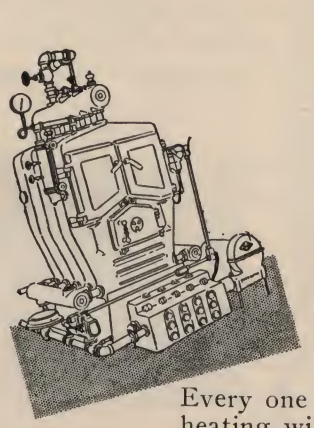
(Continued on Page 162)

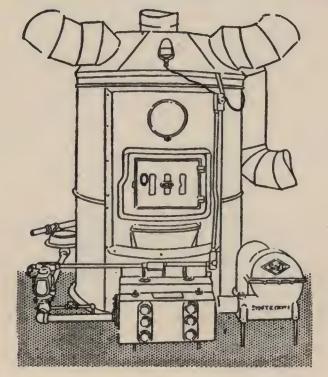

American Gas Association, Inc.
Testing Laboratory
ORIFICE SIZE
DETERMINATION CHART
Constructed From Formula:-
A = I √d / 1658.5 K V √H
K - Experimental Values for Discharge Coefficients of Orifices in Spuds of Types I and II
Key:
Align in Order Indicated by Numbers
V - Heating Value ~ B.t.u. per Cu. Ft. x 100
d - Specific Gravity
H - Pressure ~ Inches Water
P - Products
I - Heat Input ~ B.t.u. per Hour x 1000
Orifice Spud of Type I
Orifice Spud of Type II
Q - Discharge ~ Cu. Ft. per Hour
Orifices Type I ~ Drill Sizes
Orifices Type II ~ Drill Sizes
Orifices Type II in Range Cock ~ Drill Sizes

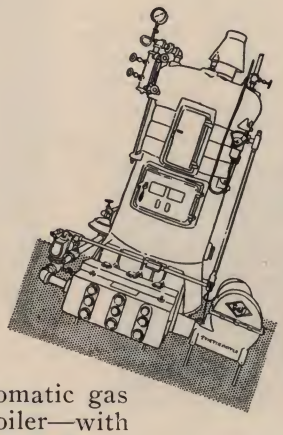
SWEET & DOYLE FOUNDRY & MACHINE COMPANY

TROY, NEW YORK

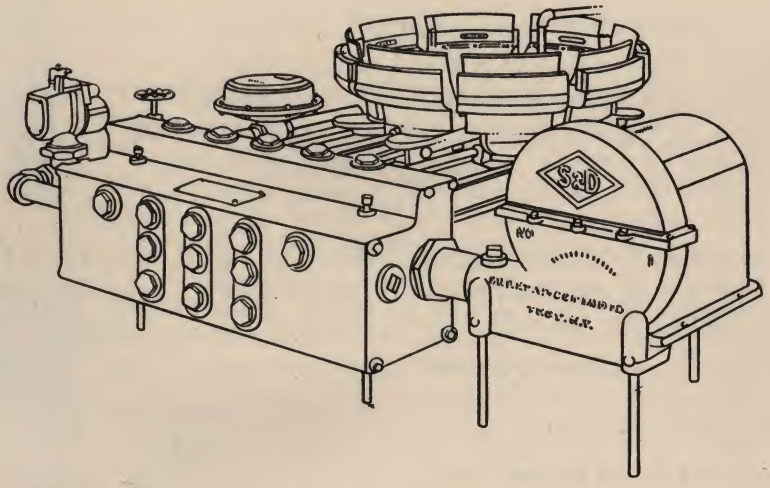
PRODUCTS: Domestic Gas Burners for House Heating, Industrial Gas Burners, Industrial Gas Furnaces, Industrial Gas-Air Control Valves, Ingot Moulds, Gray Iron Castings, Wood and Metal Patterns, Special Machinery.







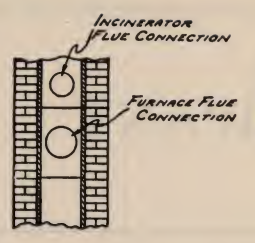
Every one of your customers may now enjoy automatic gas heating with never a thought about furnace or boiler—with their heating worries gone forever! Such is the convenience provided by a Sweet & Doyle Gas Burner—and at reasonable cost.



The S. & D. Conversion Burner utilizes gas at only two inches pressure at the regulator. This gas passes through an orifice and then a spud into a mixing chamber when it is mixed with air whose source is a practically noiseless blower. The proportioned mixture passes through an extended venturi tube and is delivered to the flame spreader port. At this point it is under the influence of a safety air curtain that adds less than 8% of secondary air. These features, plus a hermetically sealed ash pit, assure maximum boiler efficiency at all times. We also include safety pilot, low water and pressure protection and automatic room thermostat control. In the event of an electric supply failure, gas may be controlled by manually operating the automatic Gas Valve.

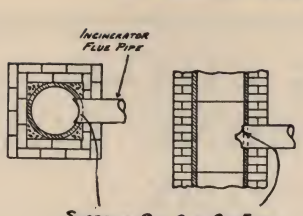
Easily installed in Vapor, Steam or Hot Water Boilers, both round or square, and for Hot Air Furnaces.

Write Today **S&D** *for Literature*



Correct Arrangement Of Furnace And Incinerator Flue Openings In Chimney.

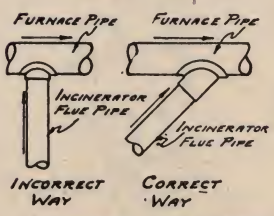
Exhibit "A"



Shorring Cut Out On End Of Incinerator Flue Pipe When Inserted In Round Chimney Interior

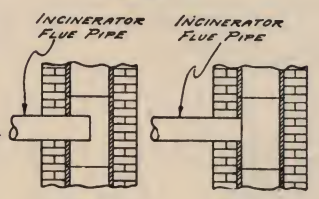
Correct Installation Of Incinerator Flue In Chimney Having Round Interior.

Exhibit "B"



Incorrect And Correct Method Of Coupling Incinerator Flue Pipe With Furnace Flue Pipe.

Exhibit "C"



Incorrect And Correct Method Of Inserting Incinerator Flue Pipe Into Chimney. Never Allow Incinerator Flue Pipe To Project Into Chimney Flue.

Exhibit "D"

diameter, should be not less than ten inches. (See Exhibit "B" for proper installation.) For rectangular flue, inside dimension should measure not less than 7½ x 11½ inches.

7. Flue pipe should be at least 22 U. S. Standard gauge, preferably galvanized, and be cemented at point where it enters chimney.

8. When incinerator and furnace are connected to the same chimney it may be necessary, during warm weather when furnace is not in operation, to close damper on furnace line.

9. A non-tight damper on incinerator flue line, allowing at least 25% passage when closed, is advisable. Damper should be partially closed when load consists of dry combustible material only. The resultant hot fire would otherwise tend to overheat flue pipe.

A RAPID METHOD OF DETERMINING CONSUMPTION OF GAS FOR HOUSE HEATING

1. Total cubical contents of rooms heated times 2 air changes per house, times .02, times temperature rise desired equals B.t.u.

2. Total square feet of wall area of rooms heated, less square feet of glass, times .3 times temperature rise desired, equals B.t.u.

3. Total square feet of glass of rooms heated times 1.1 times temperature rise desired, equals B.t.u. required.

4. Add 15 per cent of total B.t.u. required for heat losses.

5. Furnace based at 80 per cent efficient, divide total B.t.u. required by 80 per cent of the B.t.u. gas per foot to be used. This equals the consumption of gas per hour.

Example: Room 24x24x9 with 50 sq. ft. of glass, with 550 B.t.u. gas and a 40 degree rise in temperature.

No. 1—Cubical contents..... 5184
No. 2—wall area 864
No. 3—square feet glass..... 50

No. 1— 5184
2 Air changes per hr.
10368
.02
207.36
40 temperature rise
8294.4 B.t.u. required for cubical contents.

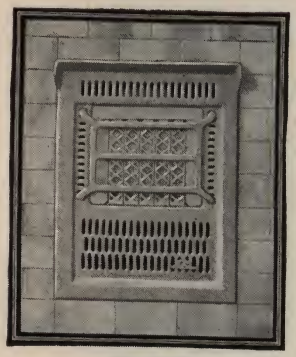
THE GUARDIAN GAS APPLIANCE CO.

1364 East 47th St., Cleveland, Ohio, U. S. A.

Approved by the American Gas Association

No. 14-51
A moderate-price model

No. 10-52
Beauty at Low Price



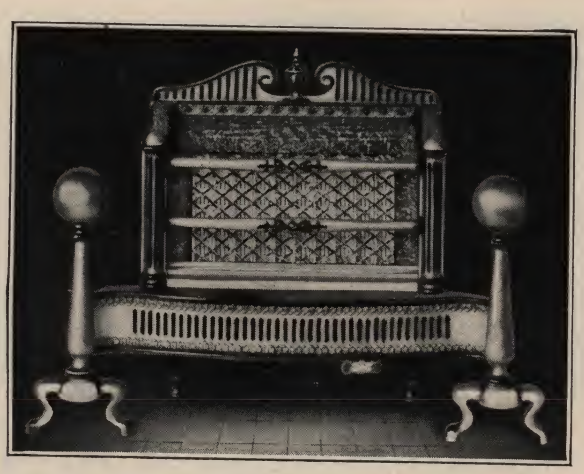
No. 5-X

BATHROOM HEATER

No. 5-X, shown here, has white, vitreous enamel, heat-deflecting hood, removable front, double insulation. Vented or without vent.

AIR CIRCULATING HEATERS

A complete line, including the beautiful No. 10-36 model shown here.



Guardian

RADIANT HEATERS

22 Fireplace, Portable and Wall Styles Direct Ray and Air Circulating Types for Natural and Manufactured Gas

Guardians are nationally-advertised heaters of distinguished beauty. Their design has constantly been refined and perfected. Today they are authentic embodiments of the periods from which their inspiration was derived.

Their **Cordeveaux** finish is exclusive to Guardian. It has the rich patina of mellow old bronze. It will not rust, crack, peel, tarnish or burn off—in the dealer's stock or in use. It is as easily cleaned as polished marble.

The Guardian burner gives a sharp, even flame—and complete combustion—at all pressures. No fumes. No "pop-back."

All sizes—7, 10 and 14 elements.

No. 10-36

Write for prices and sales plan.

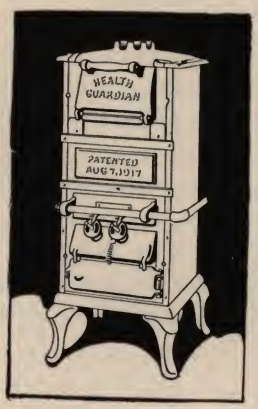
in the Cordeveaux finish

AT LEFT

No. 10-56
The new Colonial Guardian

No. 10-55
A popular Guardian refined for 1928

No. 14-41
For those who want the finest



ODORLESS INCINERATOR

Reduces a bushel of wet garbage or waste to a pint of dry ash in 45 minutes or less. Easily operated. Requires no attention. Sterilizes itself. Portable or built-in types. Black Japan, white or gray enamel finishes.

No. 2— 864
50 less sq. ft. of glass
814
.3
244.2
40 temperature rise
9768 B.t.u. required for walls.

No. 3— 50
1.1
55.0
40 temperature rise
2200 Bt.u. required for glass.

No. 4—Summary

cu. contents	8294 B.t.u.
Wall Area	9768 B.t.u.
Glass	2200 B.t.u.
	20262 B.t.u.
	3030 B.t.u. 15% ht. loss
	23292

No. 5—440 into 23292 equals 52 cu. ft. of 550 B.t.u. gas per hour. No. 40 furnace capacity 75 cu. ft. per hr.

COMPARISON OF COAL, OIL AND GAS AS HOUSE HEATING FUELS

The accompanying charts show the relative costs of coal and gas, and oil and gas as house heating fuels. Examples of their use are given on the charts themselves. The latter may be used for determining any of the factors, provided that the others are known. Thus when the grade and cost of the competitive fuel, etc., are known, it is possible to calculate the gas rate necessary to make the cost of gas heating equal to that of coal or oil, or when a given consumption of coal or oil is known, the consumption of gas may be found. If larger amounts of fuel than are covered by the scales of the charts are used, then the problem may be solved by using one-half, one-fifth, or one-tenth of the amount, working through the problem and multiplying the result by 2, 5 or 10, respectively.

The following table shows the efficiencies for seasonal operations with various fuels in house heating practice:

	Per Cent.
Anthracite coal	49
Bituminous coal	41
Coke	49
Oil in round boiler	47-55
Oil in sectional boiler	51-60
Oil in special boiler	60-64
Oil in average installation	50-55
Gas	72

These figures converted to the basis of gas efficiency are as follows:

	Per Cent of Gas Efficiency
Anthracite coal	68
Bituminous coal	51
Coke	68
Oil in round boiler	59-69
Oil in sectional boiler	63-75
Oil in special boiler	75-80
Oil in average installation	63-69

The oil-gas chart is based on the formula.

$$\frac{\text{Cost of gas} \times 1000}{\text{Gas rate, dollars/1000 cu. ft.}} \times \frac{\text{B.t.u./cu. ft. of gas}}{\text{B.t.u. gal. of oil}} \times \frac{100}{\text{Efficiency of oil referred to gas}} \times \frac{\text{Oil rate, cents/gal.}}{100} = \text{Cost of Oil}$$

REZNOR MANUFACTURING COMPANY

MERCER, PENNA.

No. 15

REZNOR GAS HEATERS

Comprise a line of types, sizes and models so broad as to meet any conditions of demand, application, taste or pocketbook.

No. 150

REZNOR ORTHORAY heaters embody the results of forty years' experience in the development and manufacture of high-grade gas heaters for the home. These heaters include a complete line of fireplace and portable models in attractive and correct period and conventional designs.

The two REZNOR ORTHORAY models illustrated are new for 1929 and well represent the values offered by the Reznor line. No. 15 is one of a series in four sizes. Andirons are available and attachable to any heater of the series. No. 150 is an attractive sheet steel type in three sizes. Orthoray burners. Solid backwall and hood of best refractory in permanent color. Wide or double glowers. Wide, solid brass hearths. A handsome, complete catalog is available on request.

TYPE 1-UR
Patents Pending

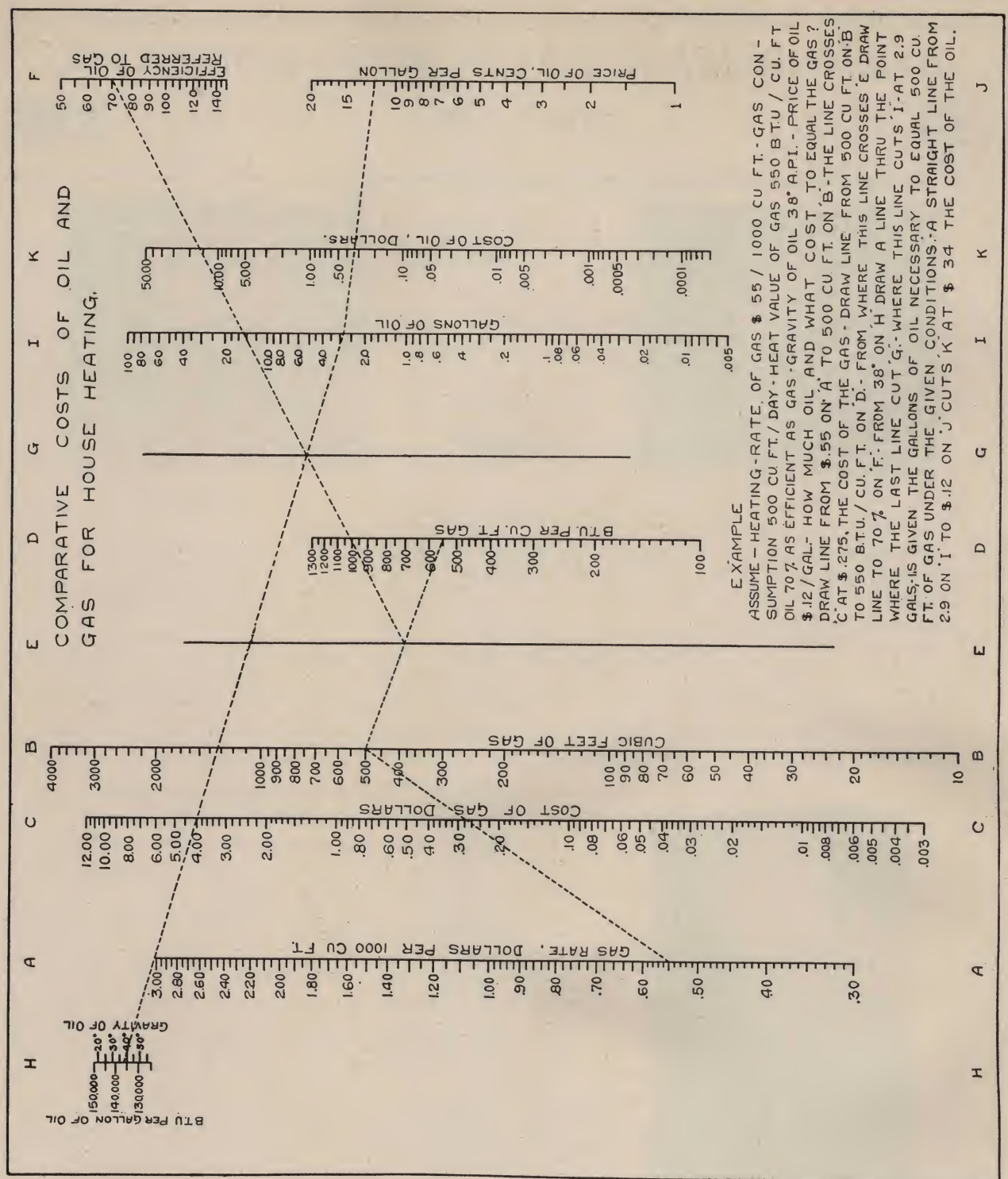
REZNOR WARM AIR CIRCULATING HEATER — TYPE 1-UR

A distinct engineering triumph specially suited to heating of large offices, store rooms, schools and churches, picture theatres, depots, hotels, post-offices, etc. Also in galvanized casing for factories, warehouses, garages, etc.

Scientifically designed combustion unit of grey iron cast in one piece without joints. Cast iron base and legs. Reznor super burner and venturi mixer tube with machined fits. Heavy steel plate casing insulated. Natural or forced circulation with built-in electric fan. Will last a lifetime. Suitable in appearance to any surroundings.

High efficiency—absolutely fire safe—no hot zone near heater—nothing to leak, run dry, burn or blow up. Automatic control. Minimum of installation expense. Quick warming up capacity, uniform temperature, simplicity, absence of dirt and labor. Dimensions 16″ x 35″ x 56″ high. Standard finish, maroon or office green Egyptian lacquer. Also available in grained walnut. A heater ideal for new buildings—effecting great economies in alterations —very practical in helping out present systems which are too small.

Reznor Gas Heaters Are Sold With the Guarantee, "Satisfaction or Your Money Back"



The figures for the efficiency of oil referred to gas may be taken from the above table. About 50 per cent of the oil used in domestic burners is 38°-42° furnace oil, 40 per cent is 28°-32° light fuel oil, and 10 per cent 24° fuel oil. These oils are usually most expensive on the east coast and gradually decrease in price to a minimum on the west. The price of the 38°-42° oil ranges from 10c a gallon on the east coast to 6c on the west coast, the 28°-32° from 9c to 5c, and the 24° oil from 8c to 4c. These prices are for tank wagon delivery; oil sold in small quantities will range two to three cents a gallon higher in price.

American Gas Catalog and Handbook

CRANE CO.

New Type Premier, Keystone, Royal and Marvel Storage Gas Water Heaters

836 SOUTH MICHIGAN AVENUE, CHICAGO, ILL.

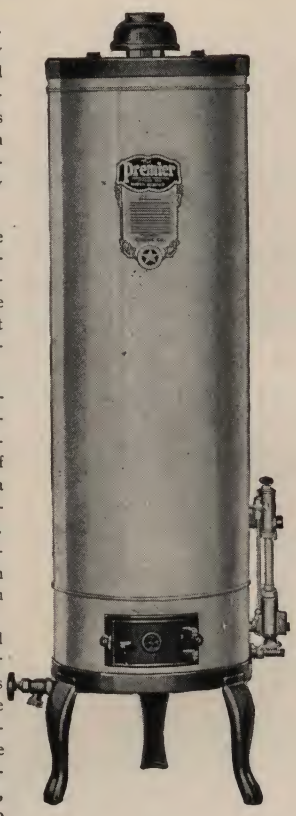
For list of branches and sales offices, see page 141

THE NEW TYPE PREMIER INSULATED AUTOMATIC STORAGE GAS WATER HEATER.

All sizes approved by American Gas Association Laboratory.

The New Type Premier is an insulated storage water heater which provides a constant supply of piping hot water instantly at minimum cost. Its operation is entirely automatic, and it is built to give positive satisfaction and enduring service. The Premier has no heating coils and is practically lime-proof. It is silent, safe and odorless.

Operation—The New Type Premier is automatic in action. A positive "instant-action" thermostat controls the lighting and extinguishing of the blue-flame burner. The tankful of water is held at any desired temperature between 80° and 190° F. The moment this temperature is reached the thermostat shuts off the gas supply to the main burner. An abundant supply of Instant Hot Water is always ready at the turn of a faucet.



The Brass Heating Element—The scientifically designed heating element in the Premier secures maximum heat from gas burned. Made quickly removable by copper gasket and bushing construction. Circulating pipes are copper.

Thermostat Control—The simple design of the Premier thermostat insures long years of accurate, dependable service. The principle of the thermostat is based upon a natural positive law of physics—that copper expands when cooled. The working parts consist of a copper tube, to which is attached an Invar rod, operating in conjunction with a small set of simple levers. When hot water is drawn and cold water enters the tank, the copper tube contracts, the Invar rod pushes against the levers, which raise the Bronze ball, opening the gas outlet to the burner. Then, as the water is heated, the copper tube expands and allows the ball to drop, shutting off the gas instantly. No gas is wasted. The action is simple, quick and positive. It is the cushion spring under the ball that causes it to snap up and down so quickly that the burner is in full blast instantly or is extinguished completely—except, of course, for the tiny pilot light. The thermostat is easily adjusted to maintain any temperature desired. Low gas or water pressures do not affect its operation.

Prem-O-Stat Safety Gas Control, a positive acting sentinel always on duty to shut off the main gas supply to the heater should the pilot light be extinguished unknowingly, is standard equipment on the Premier.

Burner—The Premier burner yields a clear blue butterfly shaped flame. This burner is a complete departure from former types of gas burners and is an exclusive feature of Crane Heaters. It requires no air or gas adjustments and cannot backfire, thereby minimizing service requirements.

Insulation—When water is once heated in the Premier it stays hot for many hours. The heavily insulated storage tank allows only a slight radiation loss. A thick jacket of Heat Seal asbestos completely surrounds the storage tank and heating chamber beneath.

Storage Tank—The Premier tank is heavily and thoroughly galvanized both inside and out. Or the tank may be of heavy copper, if desired. All tanks are tested to 300 pounds hydrostatic pressure.

Super Heat Deflector—Located in the flue, the deflector breaks up burned gases as they pass from the heating chamber transferring all available heat into the water.

Finish—The steel casing which covers and protects the insulation is finished in Premier gray lacquer. The top, base and doors are finished in darker gray, giving a beautiful two-tone effect.

Installation—The Premier takes standard ½" gas connections on sizes No. 2 and No. 3 and ¾" on size No. 4. Water connections are standard ¾" on sizes No. 2 and No. 3 and 1" on size No. 4.

A Size to Fit Every Need

The Premier is built in three sizes for domestic and industrial use, priced at: No. 2, $75.00; No. 3, $97.50; No. 4, $150.00. With copper tank, brass equipped: No. 2, $140.00; No. 3, $180.00; No. 4, $290.00 at the factory.

The New Type Keystone Automatic Storage Gas Water Heater

All sizes approved by American Gas Association Laboratory.

Built with the same precision as the Premier and resembling it to a great degree, the Keystone is different in construction and operation though it also furnishes Instant Hot Water at the turn of a faucet.

The Keystone graduated action thermostat controls the burner which with its blue flame gives maximum heat from gas burned. The Crane heating element, new Super Heat Deflector, and insulated tank are other great factors in the efficiency of the Keystone and which make it, at its new low price, today's greatest value.

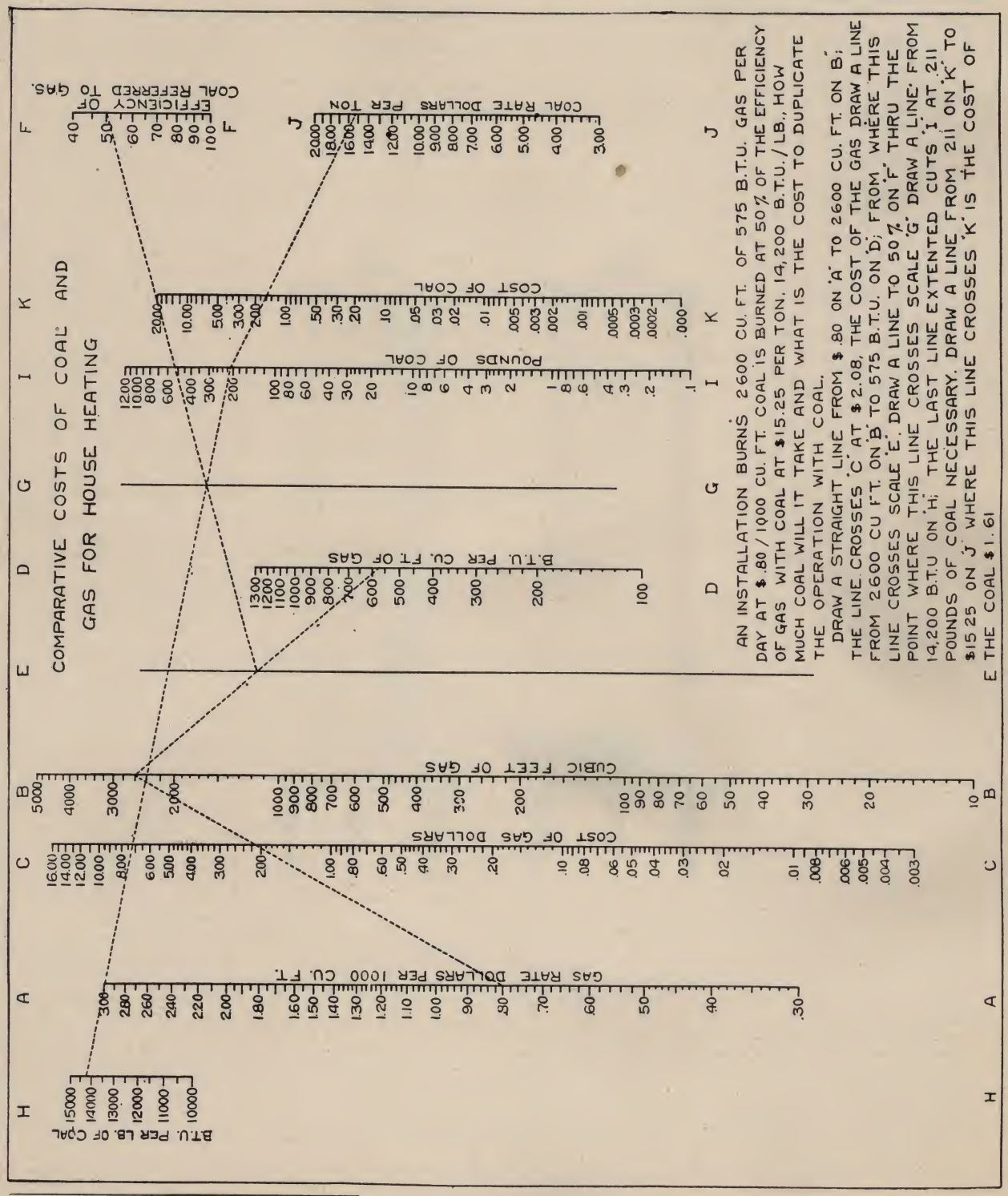
Prices at the factory: No. 2, 20 gals., $55.00; No. 3, 35 gals., $75.00; No. 4, 50 gals., $125.00

Heater and Size	Storage Cap. Gals.	No. of Burners	DIMENSIONS IN INCHES						Approx. Weight Crated Pounds
			Cold Water Inlet	Hot Water Outlet	Gas Connection	Flue Connection	Head Room Req.	Width Req. Overall	
Premier No. 2	20	1	¾"	¾"	½"	3	75	23	175
Premier No. 3	35	1	¾"	¾"	½"	3	75	27	260
Premier No. 4	50	1	1"	1"	¾"	4	80	30	425
Keystone No. 2	20	1	¾"	¾"	½"	3	75	23	170
Keystone No. 3	35	1	¾"	¾"	½"	3	75	27	250
Keystone No. 4	50	1	1"	1"	¾"	4	80	30	425
Royal No. 75	65	1	1¼"	1¼"	¾"	4	80½	34	332
Royal No. 120	93	1	1¼"	1¼"	¾"	4	92½	34	420

The coal-gas chart may be expressed mathematically as

$$\frac{\text{Cost of gas} \times 1000}{\text{Gas rate, dollars/1000 cu. ft.}} \times \frac{\text{B.t.u./cu. ft. of gas}}{\text{B.t.u./lb. of coal}} \times \frac{100}{\text{Efficiency of oil referred to gas}} \times \frac{\text{Coal rate, dollars/ton}}{2000} = \text{Cost of Coal}$$

The above table will furnish figures for the efficiency of coal referred to gas.



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TITEFLEX METAL HOSE CO.

500 Frelinghuysen Ave.
NEWARK, N. J.

An All Metal Flexible Gas Tubing for Domestic and Industrial Service

TITEFLEX is all-metal.

TITEFLEX is tight for the carrying of gas.

TITEFLEX is not affected by atmospheric conditions.

TITEFLEX is made throughout of brass which does not deteriorate.

TITEFLEX for domestic service is supplied with standard rubber slip on ends.

TITEFLEX for industrial service is supplied with standard brass pipe fittings.

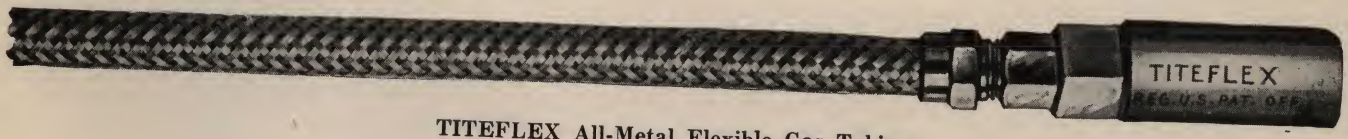
TITEFLEX is approved by the National Board of Fire Underwriters.

TITEFLEX is not affected by the heat of a gas appliance.

TITEFLEX when carrying gas has no odor.

TITEFLEX is safe.

For further details write for our catalogue.



TITEFLEX All-Metal Flexible Gas Tubing

CALCULATING SAVING EFFECTED BY INSULATION IN HOUSE HEATING

An average seven-room two-story compact house of normal frame construction is taken as an example, with dimensions and B.t.u. transmission constants as follows:

Dimension X B.t.u. Transmission Constant	Air Change per Hour	B.t.u. Loss per Degree Difference in Temp. per Hour
Cu. ft. of Contents = 12,000 × 02	1	240
Sq. ft. of Net Exposed Wall = 1600 × .25		400
Sq. ft. of Glass = 250 × 1		250
Sq. ft. of Ceiling = 650 × 2		130
		1020

The B.t.u. loss per degree difference per hour = 1,020.

The B.t.u. loss per degree difference per day = 24,480.

Assume a locality with 5,000 degree days, a maximum temperature difference of fifty degrees, 550 B.t.u. gas and a central fired system of eighty per cent efficiency.

Then

$$\text{Season's Gas Consumption} = \frac{5{,}000 \times 24{,}480}{1.020 \times 50} = 278{,}000 \text{ cu. ft.}$$

$$\text{Hot water Radiation required} = \frac{1.020 \times 50}{150} = 340 \text{ sq. ft.}$$

$$\text{Steam Radiation required} = \frac{1{,}020 \times 50}{240} = 213 \text{ sq. ft.}$$

$$\text{Maximum hourly demand for Gas Warm Air system} = \frac{1{,}020 \times 50}{550 \times .80} = 116 \text{ cu. ft.}$$

Insulation is used in the wall and ceiling construction with a B.t.u. transmission constant of .2 per hour:

$$\text{The wall constant now} = \frac{1}{\frac{1}{.25} + \frac{1}{.2}} = .11$$

$$\text{The ceiling constant} = \frac{1}{\frac{1}{.2} + \frac{1}{.2}} = .1$$

Refiguring: Dimension × B.t.u. Transmission Constant	Air Change	B.t.u. Per Degree Dif. Per Hour
Cubical contents = 12,000 × .02	11	240
Sq. ft. of Net Exposed Wall = 1,600 × .11		176
Sq. ft. of Glass = 250 × 1		250
Sq. ft. of Ceiling = 650 × .1		65
		731

B.t.u. loss per degree difference per hour = 731

B.t.u. loss per degree difference per day = 17,544

Then

$$\text{Season's gas consumption} = \frac{5{,}000 \times 17{,}544}{500 \times .80} = 20{,}000 \text{ cu. ft.}$$

$$\text{Hot Water radiation required} = \frac{731 \times 50}{150} = 243 \text{ sq. ft.}$$

$$\text{Steam radiation required} = \frac{731 \times 50}{240} = 154 \text{ sq. ft.}$$

$$\text{Maximum hourly demand for Gas in Warm Air System} = \frac{731 \times 50}{550 \times .80} = 83 \text{ cu. ft.}$$

In this example insulation affects the following savings of over twenty-seven per cent:

Gas Consumption = 278,000 — 200,000 = 78,000 cu. ft.

Hot Water Radiation = 340 sq. ft. — 243 sq. ft. = 97 sq. ft.

Steam Radiation = 213 sq. ft. — 154 sq. ft. = 59 sq. ft.

Maximum hourly demand for Gas Warm Air systems = 116 — 83 = 33 cu. ft.

THERMAL CONDUCTIVITY OF INSULATING MATERIALS

Material	Conductivity	Material	Conductivity
Air	0.175	Celotex	0.329
Pure wool	0.246	Insulex (low density)	0.400
Hair felt	0.246	Sawdust	0.404
Slag wool (loosely packed)	0.262	Planer shavings	0.416
Mineral wool (loosely packed)	0.271	Air cell asbestos (lin.)	0.500
Corkboard	0.271	Asbestos paper	0.500
Ground cork (less than 1/16 in.)	0.295	Wall board	0.500
Cabots quilt	0.321	85% Magnesia	0.500
Flaxlinum	0.329	Gypsum plaster	2.330

REFRIGERATION

Refrigeration with the aid of gaseous fuel isfor the boiling point of ether is lower than based on the principle that rapid evaporationthat of alcohol and its evaporation at ordi- produces cold. This is a well-known physicalnary temperature is more rapid than that of phenomenon, which is sometimes made usealcohol.

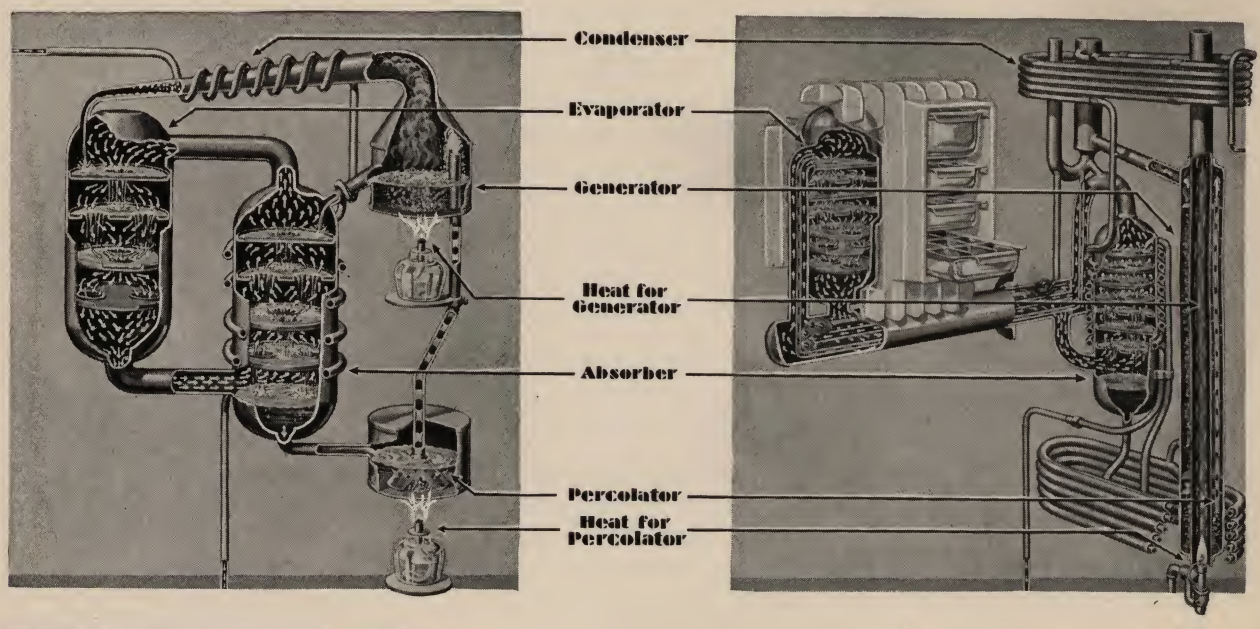
of in everyday life, without it generally being Hence, the more rapid the evaporation, the recognized. Thus, the feverish patient, whengreater the cooling effect. This can be easily sponged with alcohol or alcohol mixed withdemonstrated by pouring a little alcohol into water, is relieved. The rapid evaporation ofthe palm of the hand and blowing upon it. the alcohol produces a reduced temperatureCold is produced and the more vigorously one at the skin. Water would do the same if itblows on the alcohol, the greater the cold. In could evaporate as quickly as alcohol at thefact, it is possible to increase the rate of evap- ordinary temperature. Ether produces an evenoration of alcohol within an insulated con- greater temperature reduction than alcohol,tainer to so great a degree by this simple

means that water within another vessel, surrounded by the alcohol, will freeze.

This is the fundamental principle of the gas refrigerator, except that other fluids are used in the place of alcohol and air for technical reasons. The gas refrigerator contains a number of different parts which are made in special design and which therefore may appear other than what they really are. Their special design sometimes hides their simple function. In order to show these essential parts and their correspondence to simple devices in which alcohol and air are used, the following illustration is given. It is easy to see that the essential parts of the gas refrigerator are, first, the evaporator, then the absorber, the percolator, the generator, and the condenser.

The evaporator is simply a device for producing rapid evaporation of the liquid medium, which could be alcohol but which is chosen to be ammonia for the reason that liquid ammonia will evaporate much more readily than alcohol and greater cold will be produced. The practical evaporator is made in the form of a cylinder containing trays so that the surface over which evaporation takes place is as great as possible. The liquid ammonia will trickle down the trays, passing from one to the other over the edges and being retained in the trays by the upturned edges, so that it is given an opportunity to evaporate. The evaporated ammonia is removed by the flow of the gaseous medium through the evaporator. This can be air but is chosen to be hydrogen for practical reasons. The hydrogen leaving the evaporator at the bottom is thickly charged with ammonia.

If the evaporation were carried out in an open system, there would be no additional parts to the refrigerator, for this evaporation would produce the required cold. However, such a process would be uneconomical and hence the refrigerator is essentially a closed system. This means that the ammonia and hydrogen are used over and over again in the system. The mixture of ammonia and hydrogen must be separated. This is accomplished in the absorber in which a fluid, such as distilled water, is used to absorb the ammonia and leave the hydrogen free. Such separation takes place because ammonia is much more soluble in water than hydrogen gas. The absorber is made in the same manner as the evaporator, that is, in cylindrical form with trays to afford a large surface for the action to take place. Thus a water solution of ammonia and free hydrogen gas is obtained. The hydrogen gas plus evaporated alcohol in the evaporator is heavier than the hydrogen gas in the absorber for the ammonia has been removed. This difference in specific gravity is responsible for the circulation between the evaporator and the absorber.



American Gas Catalog and Handbook

Ammonia dissolved in water thus collects at the bottom of the absorber and it is now required that the ammonia is removed from the water so that it can again be used for the production of cold. The removal of the ammonia from the water takes place in a container which is located above the absorber. In order to lift the ammonia solution from the bottom of the absorber to the generator, which is the name given to the container, advantage is taken of the principle of the coffee percolator so as to avoid introducing any moving parts into the system. It is well known that liquids become lighter when heated and that is why the hot liquid in the bottom of the coffee percolator and in the percolator in the refrigerator rises to the top. Heat must be supplied to the percolator to effect this movement and circulation of the ammoniacal solution.

The ammonia is separated from the water in the generator, heat being used to effect this separation. The heat is supplied in the form of a gaseous flame in the gas refrigerator. This gaseous flame is arranged in such a manner within a tube surrounded with another tubular jacket that the heat required for percolation and for generation of ammonia vapors is supplied from this single source. This can be seen in the accompanying illustration.

The gaseous ammonia must be condensed, for it is the evaporation of liquid ammonia that produces cold. Ammonia vapor is condensed to liquid ammonia by being passed through a condenser which is cooled by a flow of water. The liquefied ammonia then runs into the evaporator where the cold-producing process is repeated. It is essential to cool the absorber for it becomes warm, and this is done by causing the cooling water to flow around the absorber as well as through the condenser. The water that enters the absorber may also be cooled so that it will absorb ammonia to better advantage.

The gas refrigerator may actually be operated with alcohol and hydrogen gas but ammonia is chosen instead, for less of the ammonia is required to produce a certain cold effect than alcohol. However, the apparatus has to work under increased pressure so that the ammonia will be liquefied in the condenser. This pressure is supplied by introducing the ammonia under pressure into the system which is then sealed.

The gas refrigerator is provided with thermostatic control so that the flow of gas is regulated to correspond with the amount of cooling required. Heater exchangers and a rectifier are also parts of the gas refrigerator, being added to increase the efficiency of the operation.

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For High-Pressure Fluid Discharge

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This computer solves Prof. Pole's formula for the flow of gas in pipes. All the work is done for the Engineer in making computations relative to the subject covered by the title.

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